REPORT

GIBBSTON VALLEY STATION LTD

Gibbston Valley Station Development

Resource Consent Application

Preliminary Geotechnical Investigation and Natural Hazard Assessment

Tonkin & Taylor

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Report prepared for:
GIBBSTON VALLEY STATION LTD

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1 Introduction

1.1 General

This report presents the results of a preliminary geotechnical investigation and natural hazard assessment that has been completed by Tonkin & Taylor Ltd (T&T) to support resource consent application for the proposed Gibbston Valley Station development.

This report was commissioned by Construction Management Services (CMS), on the behalf of Gibbston Valley Station Limited (GVSL), and has been completed in accordance with the terms and conditions outlined in T&T's proposal dated 08 August 2007.

The scope of work which has been completed for the purposes of this report includes:

- A review of the geotechnical data currently held on the T&T database for the area surrounding the site;
- An aerial photograph analysis to identify regional natural hazard features;
- Inspection and mapping of the existing ground surface to assess the geological and geomorphic conditions;
- Preparation of a geomorphological plan for the site and surrounding area;
- Co-ordination, supervision and documentation of test pit investigations to assess the soil materials;
- The development of a preliminary geological model for the site;
- Completion of a preliminary natural hazard assessment for the site;
- Assessment of the site investigation results to determine appropriate geotechnical design parameters sufficient to allow preliminary engineering design of the proposed development to be completed, and;
- Compilation and issue of this report that details the results of the above work.

The site work, including the geomorphic and natural hazard mapping and the test pit excavation and logging was undertaken during the week of the 8 – 12 October 2007.

1.2 Proposed Development

T&T have been issued a copy of the following concept drawings which provide details of the proposed Gibbston Valley Station development:

- Patterson Pitts drawing "Gibbston Valley Station 1st Feb 2008" dated 4/2/2008 which shows the proposed layout of the structures in the western end of the site;
- Patterson Pitts drawing "Gibbston Valley Station 1st Feb 2008" dated 4/2/2008 which shows the proposed layout of the structures in the eastern end of the site, and;
- Patterson Pitts drawing "Central Area Gibbston Valley Station" dated 24/10/2007 which shows the preferred layout of the proposed structures in the eastern end of the site to the south of State Highway 6.

For ease of reference, a copy of the above drawings is provided in Appendix A of this report. No other earthworks or construction details were provided to us prior to issue of this report.

Based on a review of the concept drawings, we understand the Gibbston Valley Station development comprises construction of the following buildings and facilities:

- 18 residential units with an average floor area of 300 m²;
- 64 duplex units with an average floor area of 200 m²;
- 50 accommodation units with an average floor area of 150 m²;
- Approximately 25 hectares of new vineyards;
- A "Winery" with private cellar;
- An 18 hole golf course with associated clubhouse and restaurant facilities;
- A spa with associated treatment rooms;
- An artisan and craftsmen centre with farmers market;
- Staff accommodation;
- An Equestrian centre;
- Cycle trails;
- Walking tracks;
- Several ponds and small lakes;
- Enhanced access along and to the Kawarau River;
- An underpass beneath State Highway 6;
- Approximately 5 hectares of orchard planting; and;
- Approximately 71 hectares of re-vegetation.

The concept drawings show the proposed golf course will occupy most of the site which lies on the north side of State Highway 6 (SH6) and the buildings that are associated with the golf course are to be located in the eastern part of the site down-slope and north of SH6. The golf buildings site is situated at the base of a small river gravel terrace and at the crest of some steep Schist rock bluffs which lie upslope of the Kawarau River.

Other structures will be constructed at the base of the large terrace which lies upslope and south of SH6, in the vicinity of the existing farmhouse buildings, winery and vineyard which is to be enlarged as part of the proposed development. The concept plans do not show if the existing vineyard irrigation pond will be retained.

We have not been provided with any development plans for the proposed equestrian centre which is to be located in the south-eastern region of the site. Only limited geotechnical investigation works have been undertaken in this area.

2 Site Description

2.1 General

The site is located approximately 20 kilometres east of Queenstown and is located on the southern slopes of the Gibbston Valley between Queenstown and Cromwell. Figure 1a, Appendix B, shows the location of the site.

The Kawarau River, which is located within a thin incised gorge, marks the northern boundary of the site. SH6 runs through the northern part of the site, and approximately parallel with the northern site boundary, for a distance of approximately two kilometres.

The western extent of the site is bordered by tourist facilities associated with the Kawarau Bridge bungy jumping operation on the north side of SH6 and by the Gibbston Valley Winery operation to the south of SH6.

The eastern side of the site is bounded by vineyards associated with the Peregrine Winery on the north side of SH6, and, south of SH6, is located slightly to the east of Resta Road. Resta Road will provide access to the proposed equestrian centre, which is to be located south-east of the main development.

The southern boundary of the site is located upslope of the crest of a large fluvial-glacial outwash gravel terrace.

An unnamed vineyard and associated winery buildings are currently located in the eastern part of the site, adjacent to and south of SH6, and on either side of Resta Road. A medium sized irrigation pond is located in the south-west corner of the vineyard and a residential farmhouse and associated structures are located approximately 600 metres to west of the vineyard.

The remainder of the site is currently used as farmland and several farm buildings and structures are scattered across the site. Numerous farm tracks provide vehicle access around the site.

Areas where historic opencast mining operations have been undertaken were observed at the crest of the Kawarau River gorge along the northern boundary of the site. Evidence of historic mining activities include the presence of tailings and disused structures such as rock walls and channels.

The vegetative cover across the site ranges from grass, scrub and scattered trees in the farmland areas to grape vines in the eastern part of the site. In-situ schist bedrock is also exposed at the surface in scattered locations.

A summary of the general site observations are shown on the Engineering Geological Site Plan, which is presented as Figure 1c in Appendix B.

2.2 Topography

Topographic contours for the site are shown on the Patterson Pitts drawings (refer to Appendix A) and this information has been used to develop all of the T&T plans and cross-sections which are presented in this report.

A series of geotechnical cross-sections have been developed by T&T which summarise the ground surface topography across the site. These cross-sections are presented as Figures 2a to 2p in Appendix B. The location of the geotechnical cross-sections are shown on Figures 1b and 1c (Appendix B).

The site topography varies considerably; ranging from very steep slopes, including some vertical bluffs adjacent to the Kawarau River, to flat and gently sloping land adjacent to SH6.

The elevation of the site rises from 300 m above mean sea level (amsl) at the level of the Kawarau River, to approximately 500 m amsl on the southern boundary. Upslope of the site, the ground surface reaches an altitude of more than 1200 m amsl at the top of the adjacent mountain ranges.

The site is dominated by two levels of gently to moderately sloping gravel terrace surfaces offset by a steep terrace face. Most of the proposed development is situated on the lower terrace.

From the southern boundary the ground surface typically slopes gently in a northerly direction until it meets the crest of the fluvial-glacial outwash gravel terrace face. This terrace face comprises a moderately steep to steep slope and results in a change in elevation of approximately 100 metres. Several large alluvial fans have formed down-slope of the terrace face. These alluvial fans have developed over an area of gently to moderately sloping river gravel terraces. SH6 passes across this area.

In the west of the site the alluvial fans extend almost to the northern boundary and cover much of the underlying river gravel. In the eastern part of the site, where the alluvial fans are not as extensive, two different river gravel terrace levels are observed. These are typically offset by up to 10 metres elevation by a moderately steep to steep terrace face. The river gravel terraces extend to the top of the bluffs which mark the upper extent of the Kawarau River gorge and the northern boundary of the site. The ground surface falls very steeply from the top of these bluffs to the Kawarau River.

2.3 Surface Drainage

Several watercourses flow in a northerly direction across the site and drain into the Kawarau River. These watercourses cut incised gullies into the higher terrace faces and spread alluvial fans over the lower terraces. Water was not flowing in the base of all the incised gullies at the time of T&T's site work; however, water was flowing in Toms Creek, which is located in the central part of the site, and in the unnamed streams to the east and west of the Gibbston Valley Winery. A small water flow was observed in the unnamed gully upslope of the winery irrigation pond that is located in the eastern part of the site; however, this flow did not cross beneath SH6.

The water flow within some of the smaller gullies has been partially captured and diverted for irrigation purposes.

The water flow from the gully which is located east of the Gibbston Valley Winery was being partially stored in what appeared to be a relatively new containment structure located upslope of the winery.

The flow from the unnamed gully that is located in the eastern part of the site and upslope of the winery irrigation pond was partially diverted into a small irrigation pond which fed a disused irrigation race which subsequently discharges over farmland.

A water diversion race was observed to the west of the existing farmhouse at the base of the glacial outwash terrace. This water race appears disused and is thought to have formally provided water for agricultural and domestic purposes.

Several areas of swampy ground were observed near the top of the bluffs which are adjacent to the Kawarau River. These areas of swampy ground were often located near to, or within, areas of historic mining.

3 Geotechnical Investigations

The following geotechnical site investigation works have been completed by T&T for the purposes of this report:

- A walkover inspection of the site by an engineering geologist, and;
- 23 test pits excavated to a depth of between 2.2 and 4.0 metres below the existing ground surface.

The location of the test pit excavations measured on site using a handheld Garmin® GPS unit which has a minimum 6-metre accuracy. The locations of the test pits excavations are shown on Figures 1b and 1c in Appendix B. A copy of the test pit logs is provided in Appendix C.

The test pit locations were chosen to provide broad information regarding the surficial geology of the whole site with an emphasis on areas where the concept drawings indicate new buildings are to be constructed.

An additional 30 shallow test pit excavations were undertaken by Duffil Watts Consulting Group (DWK) as part of a water infiltration assessment. The locations of these test pits are also shown on Figures 1b and 1c. Three of the test pit locations (T&T test pit locations TP4, TP20 ad TP21) were used for both geotechnical and infiltration assessment purposes.

An engineering geological and natural hazard appraisal was also undertaken by T&T to assess the geomorphology and surficial conditions which underlie the site and identify any natural hazards that exist. Figure 1c in Appendix B presents an Engineering Geological Site Plan of the site that summarises the location of the natural hazards which were identified during the walkover inspection of the site.

4 Subsurface Conditions

4.1 Geology

Published geological maps of the Wakatipu area [1] indicate the site is underlain by schist bedrock. Quaternary sediments comprising 330,000 to 370,000 year old glacial outwash gravel and younger 120,000 to 190,000 year old outwash gravel and alluvial fan deposits are shown to overlie the bedrock material.

The published geological map defines a large area of bouldery schist breccia /landslide deposit which is located immediately east of Toms Creek. This landslide deposit is labelled as the Resta Road Landslide on Figures 1a and 1c in Appendix B.

The geological map indicates the Nevis Fault underlies the extreme western extent of the site and runs close to where the existing Gibbston Valley Winery facility is located.

4.2 Geological Setting

The regional basement bedrock comprises ice-scoured Hasst Schist. Several periods of glacial advances have carved board u-shaped valleys into the Schist bedrock. As the glaciers have retreated, layers of fluvial-glacial outwash gravels have been deposited in the base of the valleys. The fluvial glacial outwash gravels have been eroded and younger river gravel terraces and alluvial fans have been formed. The river gravel terraces and alluvial fan deposits cover much of the area of the proposed development.

The Kawarau River currently occupies a deeply incised gorge in the bottom of the broader Gibbston Valley.

In the Gibbston Valley aggradational fluvial-glacial outwash gravel has been deposited over the underlying schist bedrock. The Kawarau River has down cut through the fluvial-glacial outwash gravel material to form a significant terrace face and younger river gravel terrace surfaces have been formed.

At some time a lake has partially covered the site that has resulted in the deposition of lake sediments. These materials were observed in the test pit excavations that are located near to the unnamed winery.

Alluvial fans have formed as streams have cut into the glacial outwash gravel terrace face, depositing alluvial fan deposits comprising silt, sand and gravel on top of the river gravel terraces.

4.3 Tectonic Setting

The schist bedrock has been subject to tectonic deformation during uplift of the Southern Alps. This uplift has resulted in movement on a series of NNW trending faults, one of which is the Nevis Fault.

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[1] Turnbull, I.M. (compiler) 2000. Geology of the Wakatipu area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 18. 1 Sheet + 72 p. Lower Hutt, New Zealand. Institute of Geological and Nuclear Sciences Limited.

Published geological maps [1] indicate the Nevis Fault underlies the western extent of the site. The Nevis Fault is part of the Nevis-Cardrona Fault system which is considered a major active fault system with a reverse sense. The Institute of Geological and Nuclear Sciences (IGNS) states the return period for rupture of the Nevis Fault is 5,000 to 10,000 years.

The date of the most recent surface rupture of the Nevis Fault has not been established and the field investigations found no evidence to suggest any recent movement has occurred on this fault.

The geological maps show the Nevis Fault splits into two splays just north of the Kawarau River. Both splays underlie the western extent of the site and continue in a south/south westerly direction.

Figure 1c shows the inferred position of the Nevis-Cardrona fault lines and/or fault zones that were mapped by others during previous unpublished work on the site.

4.4 Stratigraphy

4.4.1 Introduction

Figures 2a to 2p, in Appendix B, present geological cross-sections through the site and summarise the inferred sub-surface stratigraphy. The locations of the test pit excavations and geotechnical cross-sections are shown on Figures 1b and 1c in Appendix B.

The sub-surface materials that were encountered during the site investigation works typically comprise:

- A 0.0 to 0.6 metre thickness of organic topsoil, overlying,
- A 0.0 to 1.0 metre thickness of colluvium (only encountered in TP7, 22 & 23), overlying,
- A 0.0 to 1.5 metre thickness of remnant topsoil (only encountered in TP3, 5, 6, 16, 17, 18 & 19), overlying,
- A 0.0 to 3.1+ metre thickness of alluvial fan gravel deposits, overlying,
- A 0.0 to 3.8+ metre thickness of lake sediments (only encountered in TP8, 11, 12, & 13), overlying,
- A 0.0 to 1.4+ metre thickness of fluvial-glacial outwash gravel (only encountered in TP13), overlying,
- A 0.0 to 2.9+ metre thickness river gravels, overlying,
- Schist bedrock.

Some uncertified end tipped fill was observed near the swampy ground to the north of the Gibbston Valley winery (see Figure 1c).

A veneer of organic topsoil covers the site to depths varying between 0.2 to 2.1 m. Topsoil was not observed in test pits TP1 and TP2 due to prior earthworks having been undertaken in the area. No topsoil was present where schist bedrock was exposed at the surface. Generally the topsoil was between 0.2 and 0.5 m thick. A thick layer of topsoil, which extended to 2.1 m depth, was observed in TP3. This test pit is located at the site of a previous residential dwelling.

Localised occurrences of fine-grained lake sediments and colluvial material were identified in four and three test pit excavations respectively.

The alluvial fan gravel deposits were encountered in 13 of the 23 test pits which were supervised by T&T. These deposits generally have a higher silt and fine sand content, are better graded (has many different clast sizes) and are more rounded than the river gravel deposits. The maximum clast size of the alluvial fan deposits is generally coarse gravel.

The river gravel deposits generally comprise large sub-angular cobbles supported in a medium to coarse gravel and sand matrix. This deposit was observed in 15 of the 23 test pits which were supervised by T&T.

No test pit excavations were undertaken within the fluvial-glacial outwash gravel material which lies upslope of the large terrace face that defines the southern extent of the proposed development. Material thought to be representative of the fluvial glacial outwash gravel material was observed in the bottom of TP13. This deposit was found to underlie the Lake Sediment deposits and was observed to comprise very sandy gravel.

Schist bedrock was exposed at the existing ground surface in numerous outcrops to the north of SH6. A single surficial outcrop of schist was observed south of SH6. The foliation of the schist bedrock was observed on site to typically dip at between 56 and 81° to the southwest (230 - 260°). Site observations indicate the surface of the Schist bedrock undulates and the depth to Schist rock can quickly change over a short distance.

A summary of the site stratigraphy, as encountered by the test pit excavations, is presented in Table 4.1 and discussed in more detail in the following sections.

4.4.2 Stratigraphic Summary - South of SH6

Typically the test pit excavations which were undertaken to the south of SH6 showed the following stratigraphic sequence:

- Medium dense to dense, silty sandy alluvial fan GRAVEL, overlying,
- Medium dense to dense, sandy river GRAVEL.

Test pit excavations TP8, TP11, TP12 and TP13 encountered sub-horizontally laminated lake sediments, comprising very stiff to hard, micaeous sandy SILT.

In the TP13 excavation, a layer of medium dense to dense sandy gravel was encountered underlying the lake sediments. This material was inferred to be fluvial-glacial outwash gravel of a similar origin and age to the material that makes up the large terrace face located south of the area of the proposed development.

Test pit excavations TP7, TP22 and TP23 encountered silt and silty gravel material that is inferred to be colluvium.

Schist bedrock was not observed in any of the test pit excavations which were undertaken on the south side of SH6.

4.4.3 Stratigraphic Summary - North of SH6

North of SH6, river gravel deposits comprising moderately dense to dense sandy GRAVEL of varying thickness were typically encountered immediately below the surficial topsoil layer. Thin layers of silty sandy river GRAVEL were identified in test pit excavations TP15 and TP19.

Site observations and test pit excavations indicate Schist bedrock is generally close to the existing ground surface on the north side of SH6.

SCHIST bedrock was positively identified, or inferred to be encountered, in all of the test pit excavations which were undertaken on the northern side of SH6.

SCHIST bedrock was generally encountered in the northern test pits at a depth between 0.4 and 3.4 m below the existing ground surface. TP18 was terminated at a depth of 3.4 m on material too hard to excavate and inferred to be Schist bedrock. Test pit excavations TP15, TP16, TP19 and TP20 were also terminated when further excavation was prevented due to the strength of the underlying material, inferred to be moderately weathered, fair to good quality schist bedrock. Weak, highly weathered, poor quality schist bedrock was excavated from test pits TP14, TP17 and TP21.

SCHIST bedrock was exposed at the ground surface very close to the site of test pits TP14, TP15, TP19, TP20 and TP21.

Table 4.1 Test Pit Summary

Test Pit Number	Layer Extent	Topsoil	Colluvium	Lake Sediments	Alluvial Fan Gravel	River Gravel	Bedrock
TP1	Depth				0.0 - 3.1 m		
	Thickness				>3.1 m		
TP2	Depth				0.0 - 3.1m		
	Thickness				>3.1m		
TP3	Depth	0.0 - 2.1m			2.1 - 2.4m		
	Thickness	2.1m			>0.3m		
TP4	Depth	0.0 - 0.5m			0.5 - 3.6m		
	Thickness	0.5m			>3.1m		
TP5	Depth	0.0 - 1.0m			1 - 1.5m	1.5 - 3.4m	
	Thickness	1.0m			0.5m	>1.9 m	
TP6	Depth	0.0 - 0.9m				0.9 - 3.8m	
	Thickness	0.9m				>2.7m	
TP7	Depth	0.0 - 0.3m	0.3 – 1.3		1.3 - 3.5m		
	Thickness	0.3m	1.0 m		>2.2m		
TP8	Depth	0.0 - 0.3m		1.7 - 3.4m	0.3 - 1.7m		
	Thickness	0.3m		>1.7m	1.4m		
TP9	Depth	0.0 - 0.3m			0.3 - 1.5m	1.5 - 3.5m	
	Thickness	0.3m			1.2m	>2 m	
TP10	Depth	0.0 - 0.2m			0.2 - 2.0m	2.0 - 3.5m	
	Thickness	0.2m			1.8m	>1.5 m	
TP11	Depth	0.0 - 0.3m		0.3 - 2..0m		2.0 - 3.6m	
	Thickness	0.3m		1.7m		>1.6m	

Test Pit Number	Layer Extent	Topsoil	Colluvium	Lake Sediments	Alluvial Fan Gravel	River Gravel	Bedrock
TP12	Depth	0.0 - 0.2m		0.2 - 4.0m			
	Thickness	0.2m		>3.8m			
TP13	Depth	0.0 - 0.2m		0.5 - 2.6m		0.2 - 0.5m (2.6 - 4.0m)	See Note 1
	Thickness	0.2m		2.1m		0.3m (>1.4m)	See Note 1
TP14	Depth	0.0 - 0.4m					0.4 - 2.2m
	Thickness	0.4m					N/A
TP15	Depth	0.0 - 0.5m			0.5 - 1.1m	1.1 - 2.5m	2.5 - 2.8m
	Thickness	0.5m			0.6m	1.4m	N/A
TP16	Depth	0.0 - 0.5m				0.5 - 2.5m	2.5 - 2.6m
	Thickness	0.5m				2.0m	N/A
TP17	Depth	0.0 - 0.8m				0.8 - 2.0m	2.0 - 3.2m
	Thickness	0.8m				1.8m	N/A
TP18	Depth	0.0 - 0.8m				0.8 - 3.4m	
	Thickness	0.8m				>2.6m	
TP19	Depth	0.0 - 0.5m				0.5 - 2.5m	2.5m
	Thickness	0.5m				2.0m	N/A
TP20	Depth	0.0 - 0.4m				0.4 - 2.4m	2.4m
	Thickness	0.4m				2.0m	N/A
TP21	Depth	0.0 - 0.2m				0.4 - 1.0m	1.0 - 3.8m
	Thickness	0.2m				0.6m	N/A
TP22	Depth	0.0 - 0.3m	0.3 - 1.5m			1.5 - 3.6m	
	Thickness	0.3m	1.2m			>2.1m	
TP23	Depth	0.0 - 0.3m	0.3 - 0.7m		0.7 - 1.3m	1.3 - 4.0m	
	Thickness	0.3m	0.4m		0.6m	>2.7m	

Note 1: Two layers of river gravel deposits were observed in TP13. The upper 0.3 m thick layer, at 0.2 to 0.5m depth, is inferred to be more recent river gravel deposits. The lower layer, which was present from 2.6m depth to the base of the test pit excavation, is inferred to represent older fluvial-glacial outwash gravels which were deposited in the Gibbston Valley prior to deposition of the lake sediments. The fluvial-glacial outwash gravels are inferred to have been deposited around the same time as the material that makes up the large glacial outwash gravel terrace in the southern part of the site.

4.5 Existing Slope Instability

Figure 1c, in Appendix B, identifies numerous zones of historic, recent and ongoing slope instability within and adjacent to the proposed development sites.

The scale of instability observed ranged from very large to small scale landslides as well as surficial erosion. Of particular note is the large landslide that is identified on the published geological maps [1], and referred to in a previous investigative report [2], as the "Resta Road Slide".

The IGNS report [2] assesses the Resta Road Slide to be currently inactive. However, smaller scale; more recent and ongoing instability in the form of small to moderate scale landslides on the steep fluvial-glacial terrace face immediately upslope of the inferred toe of the Resta Road Slide, was noted in the field, and in the IGNS report.

The approximate extent of the Resta Road Slide, as defined in the IGNS report, is shown on Figure 1a in Appendix B. The IGNS report on the Resta Road Slide states that although previously mapped as moraine, the landform is more likely to be a historic landslide comprised of displaced basement schist and overlying glacial outwash deposits. This landslide is thought to have been activated approximately 500,000 years ago after a glacial retreat from the Gibbston Valley.

The Resta Road Slide is assessed to cover some 1.5 km^2 of land area, beginning significantly upslope of the subject site and continuing to a down-slope toe, which coincides with the base of the fluvial-glacial outwash gravel terrace face, which typically marks the upslope/southerly extent of the proposed development on the subject site. Several springs and swampy areas that were observed along the fluvial-glacial gravel terrace face are thought to indicate the toe region of the Resta Road Slide.

Generally the landslide comprises hummocky land that is gently to moderately steeply sloping, however, the toe region of the landslide is located within a steep terrace face, below which is the relatively flat land that most of the proposed development will be sited upon.

Additional instability around the site in the form of minor slope failures and areas of erosion were noted in the sides of incised gullies passing through fluvial-glacial and river gravel deposits, and near the top of the bluffs of the Kawarau River Gorge in the north of the site. These areas are indicated on Figure 1c. Active landslides, most likely controlled by schist foliation shear zones, are noted on the north bank of the Kawarau River opposite the northwestern corner of the subject site.

Instability issues are addressed further in the Natural Hazards section of this report.

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[2] Thomson, R. 1994. Resta Road Slide: a re-evaluation of an area of hummocky terrain in the Gibbston Basin, Central Otago. . Institute of Geological and Nuclear Sciences, Science Report 94/33. 29p + maps and photos. Lower Hutt, New Zealand. Institute of Geological and Nuclear Sciences Limited.

4.6 Groundwater

The soils that were encountered on site were generally observed to be moist near the ground surface and drier at greater depths.

A single test pit excavation (TP3) encountered water inflow during excavation. The inflow into this pit occurred at such a high rate that no further excavation could be undertaken. The pit rapidly filled with water to a level of 2.1 m below ground level. This inflow is inferred to be representative of a perched water table and not related to the regional groundwater level.

Some areas of marshy ground were noted during the site walkover inspection. These areas are identified on c1d in Appendix B. Generally the marshy areas were located adjacent to an existing stream courses, and at the crest of the very steep slopes/bluffs upslope of the Kawarau River, along the northern boundary of the site. In many instances Schist bedrock was exposed in these areas and tailings from historic mining practices had altered the surface drainage profile. Additional springs and marshy areas were noted in the fluvial-glacial terrace face. The report on the Resta Road Slide inferred these springs marked the approximate down slope extent (toe) of the Resta Road Slide.

Perched groundwater is expected to be encountered at the contact between the Schist bedrock and the overlying soils, and at contacts between underlying less permeable and overlying more permeable soils, particularly during and following periods of high rainfall. A number of perched groundwater tables may be encountered on site due to the layered nature of the outwash gravels and alluvial deposits.

5 Natural Hazards

5.1 Introduction

Several natural hazards which could potentially affect the proposed development were identified during the site walkover survey. Each of these hazards is discussed in detail in the following sections.

Section 5.6 contains a table which summarises the results of a qualitative natural hazard risk assessment, based on the observed site conditions, and includes an assessment of the likelihood, consequence and risk of each natural hazard.

5.2 Landslides/Rock falls/Erosion

5.2.1 Landslides

Several moderately large to large recent and/or ongoing landslides are identified on the engineering geological site plan (Figure 1c, Appendix B).

A very large area of hummocky ground, located upslope of the fluvial-glacial outwash gravel terrace face, has previously been interpreted as a very large, inactive ancient landslide. The toe of this landslide, which is known as the Resta Road Slide, is interpreted to lie immediately upslope of the proposed spa; the proposed units adjacent to the vineyard; the proposed driving range; and the proposed staff accommodation. Additionally, the face of the fluvial-glacial outwash gravel terrace; in the toe area of the Resta Road Slide; show evidence of medium and small sized active and historic landslide failures.

Although the large Resta Road slide is considered inactive, a landslide hazard exists for the proposed development. Several small to medium sized slope failures are present within the toe area of the Resta Road Slide; and associated terrace face; which could potentially impact the proposed development if the hazard is not adequately planned and designed for. There is a risk that reactivation of part or all of any historic landslide, ongoing movement of an active landslide, or mobilization of a new landslide feature may affect the proposed development. The landslide hazard is greatest where proposed buildings are located immediately down slope of moderately steep to steep sloping ground and areas identified as being subject to instability in the past.

A minimum set back distance from the toe of steeply sloping ground and/or land stabilization measures such as the installation of drainage and/or shear keys may be required to minimize this hazard.

5.2.2 Erosion

Many of the slopes on the site are steep and have limited vegetation cover and several of the steeper terrace faces and incised gully slopes show evidence of surficial erosion, as do the areas at the top of the Kawarau River gorge bluffs in the north of the site.

Erosion and small scale instability is expected to continue in exposed areas during and after completion of the proposed development if proper steps are not taken to address and manage this issue. Ongoing regression at the crest of the steep slopes and bluffs could cause parts of the development to be undermined. Erosion upslope and adjacent to

any development may cause accessibility issues and/or issues associated with debris run-out.

The erosion hazard can be managed by the control of surface and storm water flows and by the planting of appropriate ground cover. Debris detention devices such as engineered earth bunds and catch fences may also be constructed to manage this potential hazard.

5.2.3 Rock Falls

Moderate to large sized schist rocks were observed on and/or near to the ground surface in various locations across the site. As some of the rocks lie on a sloping ground and a rock fall/rock roll hazard exists. There is a risk of rock falls affecting developments down-slope of areas of loose material on sloping ground. The rock fall hazard is unlikely to be realized without the mobilizing effect of another hazard, such as earthquake shaking and/or ongoing erosion.

Identification and/or designation of appropriate rock fall run out zones and building setback areas may be required. Debris detention devices such as engineered earth bunds and catch fences may also be considered.

Additionally, the concept plans indicate some of the residential units which are associated with the golf course are to be constructed on and near to exposures of schist bedrock and along the crest of the Kawarau River gorge bluffs. A rock fall/rock toppling hazard is posed by any exposed rock material that may topple during an extreme storm event, or during earthquake shaking, immediately upslope or down slope of any proposed development.

The toppling hazard is largely controlled by the orientation of the foliation of the schist and any defects within the bedrock mass.

Toppling of a rock mass upslope of development has the potential to cause inundation and/or destruction by impact, whereas toppling of a rock mass down slope of a development has the potential to cause foundation failure and building damage or collapse due to undermining.

A minimum setback distance from the crest and toe of the Schist bluffs will be required to ensure the rock toppling hazard is addressed and adequately managed. Specific investigation and design should be undertaken to confirm the building set-back distances before the layout and design of the proposed development is finalised.

5.3 Flooding/Debris flow inundation

While flooding of the Kawarau River is highly unlikely to affect the proposed development, flooding of the smaller streams that cross the site may occur which could affect the proposed development.

Flooding can be expected to cover areas close to the existing watercourses. In extreme situations a stream may occupy any part of an alluvial fan that it has created historically.

Mitigation measures, including flood control and protection works, can be engineered to reduce and manage the flood and debris flow hazard. Identification/designation of flood paths may be required for any parts of the development located near to existing watercourses. Additional hydrological modeling may also be required to design

appropriate flood control measures and/or define flood paths and building set back zones.

Debris flows pose a hazard to some parts of the development, particularly to any development near the upper parts of the alluvial fans that have formed down slope of the incised gullies in the fluvial-glacial outwash terrace face. A debris flow occurs when a low frequency/high intensity storm event causes a mass of soil and rock material to be mobilized down an existing gully or channel. When the flow encounters the wider alluvial fan, the energy is spread out over a much wider area, thus the risk decreases with distance from the mouth of the gully or channel.

5.4 Earthquakes

5.4.1 Introduction

Fault rupture and ground shaking hazards exist for the proposed development from a possible earthquake on the Nevis or Cardrona Faults, or rupture of a more distant fault, such as the Alpine Fault, which is located along the West Coast of the South Island.

The Nevis Fault line passes beneath the north western corner of the site. The Institute of Geological and Nuclear Sciences (IGNS) estimates the return period for rupture of the Nevis Fault is 5,000 to 10,000 years. The date of the last rupture of the Nevis Fault is not known.

There is a high probability that an earthquake with a magnitude of greater than 7.5 will occur along the Alpine Fault within the next 50 years.

5.4.2 Fault Rupture

A rupture of the Nevis Fault is expected to cause significant damage to structures which are located on or close to the surface expression of the rupture. Additionally, rupture of the Nevis/Cardrona fault is likely to result in significant seismic shaking.

The return period for an earthquake on the Nevis Fault is significantly long that an earthquake on this fault is unlikely to occur during the design life of the development. However, the surficial trace of any fault lines should be identified and an appropriate building set back distance instigated to manage the Nevis/Cardrona fault rupture hazard.

5.4.3 Ground shaking

Significant seismic risk exists in the region from potentially strong seismic ground shaking associated with a rupture of the Alpine Fault, and to a lesser degree from ground shaking due to localised fault rupture.

The earthquake ground shaking may be sufficient to damage and/or destroy structures as well as promote slope instability and rock falls. Ground shaking may also cause liquefaction of fine grained sediments as discussed in the following section.

Due allowance should be made for seismic loads, in accordance with the recommendations of the appropriate New Zealand codes and standards, during detailed design of the proposed development.

5.5 Liquefaction

Liquefaction can occur when saturated, loose to moderately dense sandy soils are subjected to severe or prolonged seismic shaking. Ground settlement and lateral spreading usually result if a soil undergoes liquefaction.

No layers of liquefaction susceptible soil were identified during the site investigation works and perched groundwater was only encountered in test pit TP3.

Based on the site observations which have been made to date, the risk of widespread liquefaction is assessed to be very low to nil. However, the liquefaction risk should be assessed and confirmed on a site by site basis when the final layout and design of the individual proposed buildings is finalised.

5.6 Summary of the Natural Hazards

Table 5.1 summarises the results of a subjective assessment of the natural hazards which have been identified on site to date, their likelihood of occurrence, their potential consequences, and their potential risk to property.

Table 5.1: Summary of the Natural Hazard Risk Assessment

Hazard	Likelihood	Potential Consequences (See Note 1)	Potential Risk to Property (See Note 1)
Large Scale Landslide	Unlikely	Medium	Very Low
Medium Scale Landslide	Possible	Medium	Low
Small Scale Landslide	Likely	Minor	Low to Moderate
Rock fall	Possible	Medium	Low
Erosion	Likely	Minor	Low
Flooding	Possible	Medium	Low
Debris Flow	Possible	Medium	Low to Moderate
Earthquake Fault Rupture	Very Low	Insignificant	Very Low to Nil
Earthquake Ground Shaking	Likely	Medium	Moderate
Liquefaction	Unlikely to Nil	Insignificant	Very Low to Nil

Note 1: The potential consequences and risk to property have been assessed assuming appropriate measures such as building set-back lines and civil engineering works are fully investigated, assessed and designed by appropriately qualified and experienced engineers and engineering geologists prior to commencing construction of the proposed development.

The likelihood, consequence and risk terms used in Table 5.1 are based upon Appendix 3 of the document "Draft Guidelines For Assessing Planning Policy And Consent

Requirements For Landslide Prone Land", GNS Science Miscellaneous Series 7, February 2007.

In our experience nil to moderate risk is usually considered acceptable by the statutory authorities and stakeholders. Depending on individual circumstances, moderate risk situations may require additional levels of mitigation to be undertaken to manage the risk and to meet stakeholder expectations. As a guide we would relate the "is likely to" events in Section 106 of the RMA to high to very high qualitative risk to property.

6 Geotechnical Design Parameters

6.1 General

The recommendations and opinions that are contained in this report are based upon preliminary ground investigation data obtained at discrete locations across the subject site and on historical information held on the T&T database.

Inferences concerning the nature and continuity of the subsoil investigation locations are inferred and cannot be guaranteed. The actual sub-surface conditions may therefore vary from those described.

All design recommendations which are contained in this report are subject to confirmation by additional geotechnical investigation and/or assessment once the development plans have been finalised and inspections during construction.

6.2 Preliminary Geotechnical Design Parameters

Table 6.1 summarises the preliminary recommendations for geotechnical design parameters.

Table 6.1 Preliminary Geotechnical Design Parameters

Unit	Bulk Density γ (kN/m³)	Effective Cohesion c' (kPa)	Effective Friction ϕ' (degrees)	Elastic Modulus E (MPa)	Poisson's Ratio v
Topsoil/Remnant topsoil	16.0	—	—	—	—
Colluvial Material	17.0	0	32	10 to 12	0.30
Lake Sediments	18.0	1	28	6 to 8	0.35
Alluvial Fan Deposits	19.0	0	32	20 to 30	0.35
River Gravels	19.0	0	35	30 to 50	0.30
River/Outwash Gravels	21.0	0	38	50 to 80	0.30
Schist Bedrock	27.0	40 to 300 (100 ave.)	28 to 55 (36 ave.)	>100	0.2
Schist Bedrock Defect	N/A	0	26	N/A	N/A

The stability of any excavations within Schist bedrock will be governed by the rock mass quality and the orientation and character of the rock defects at each specific location.

The Schist bedrock is very anisotropic and foliated. The foliation of the Schist can be assumed to be a plane of weakness (defect). Other defects, such as joint sets, may also be present in the rock mass which adversely affect slope stability.

The rock mass mapping which has been undertaken to date indicates the Schist bedrock has a foliation that dips towards the south west at an angle varying between 56° and 81° (moderately steep to very steep). Preliminary assessment indicates the foliation dip may create stability issues in cut excavations into the Schist bedrock.

Additional investigation pilot cuts, drilling, mapping works, and engineering assessment will need to be undertaken once the excavation locations and depths, and the final foundation locations, have been confirmed.

7 Engineering Considerations

7.1 General

The recommendations and opinions that are contained in this report are based upon preliminary ground investigation data obtained at discrete locations across the subject site and on historical information held on the T&T database.

Inferences concerning the nature and continuity of the subsoil investigation locations are inferred and cannot be guaranteed. The actual sub-surface conditions may therefore vary from those described.

All design recommendations which are contained in this report are subject to confirmation by additional geotechnical investigation and/or assessment once the development plans have been finalised and inspections during construction.

T&T considers the proposed Gibbston Valley Station development to be technically feasible; however; detailed investigation and deign of the proposed foundations, cut slopes, earthworks and retaining walls must be completed prior to the commencement of construction.

7.2 Earthworks

All fill should be placed and compacted in accordance with NZS4431:1989 and certified in accordance with Queenstown Lakes District Council standards.

The Alluvial Fan Deposits and River Gravel materials are expected to be suitable for use as engineered fill. However, sandy/silty zones within the Alluvial Fan Deposits may require blending with gravel materials to achieve a suitable fill material.

The colluvial deposits, lake sediments and uncontrolled fill deposits may be difficult to work and compact to achieve a certified engineered fill. It is recommended these deposits be avoided or alternatively used as non-structural landscaping fill, blended with alluvial fan deposits or river gravel materials or removed from the site during the earthworks. Due allowance for this should be made in the construction budget, schedule and programme.

During earthworks operations all topsoil, residual topsoil, organic matter, colluvial deposits and other unsuitable material should be removed from the construction footprints in accordance with the recommendations provided in NZS 4431:1989.

Exposure to the elements should be limited for all soils. Any bulk excavations should be left proud of the finished subgrade level by 200 to 300mm. The final cut to grade should be performed immediately prior to foundation or retaining wall construction. Alternatively, these areas can be undercut and rebuilt to formation level with hardfill should the subgrade deteriorate due to exposure.

Covering of the exposed soils with polythene sheeting will reduce degradation due to rain infiltration and surface run-off. This will be particularly important on temporary excavations.

All water should be removed from the excavations by surface drains and/or pumping where necessary. Under no circumstances should water be allowed to pond or collect

near or under a foundation slab or retaining wall footprint. Positive grading of the subgrade surfaces should be undertaken to minimise water ingress or ponding.

Robust, shallow graded sediment control measures should be instigated during construction. Should slope gradients in the exposed soil materials exceed 4%, then lining of drainage channels is recommended, e.g. with geotextile and suitably graded rock, or similarly effective armouring.

7.3 Foundation Design

7.3.1 General

Shallow foundations are expected to bear on alluvial fan deposit materials, river gravel, or schist bedrock.

All shallow foundations which are constructed upon soil should be embedded a minimum of 0.4m below the adjacent ground level to minimise the potential effects of freeze-thaw cycles.

Any new fill that is placed beneath building footprints will need to be spread and compacted in accordance with NZS 4431:1989 and certification provided to that effect. Any existing uncertified fill beneath proposed building footprints should be removed and replaced with certified fill.

Shallow foundations are recommended in those areas where the building platform subgrade comprises schist bedrock at or near the surface and/or, flat to gently sloping Alluvial Fan or River Gravel deposits.

Due to the preliminary nature of the proposed development, and the potentially variable subgrade conditions, it is recommended that detailed design of all foundations be reviewed by a Geotechnical Chartered Professional Engineer.

The foundation design for any proposed development on land sloping at greater than 10° should be undertaken by a Chartered Professional Geotechnical Engineer.

In order to minimise the risk of groundwater seepage into the finished building basements, a 100mm minimum thickness of free draining granular fill and a network of subsoil drainage pipes should be constructed beneath the ground level and basement floor slabs. The outlet of all foundation slab drains should be connected to the permanent piped stormwater system.

All foundation subgrades should be inspected by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist prior to placement of concrete to confirm the subgrade conditions are in accordance with the assumptions and recommendations provided in this report.

7.3.2 Shallow Pad and Strip Foundations

7.3.2.1 Foundations Bearing on Schist Rock

For foundations bearing on poor quality highly weathered schist bedrock a working bearing stress of 1,000 kPa is recommended for a 300mm wide by 300mm deep footing. This corresponds to a factored (ULS) bearing capacity of approximately 1,500kPa and a geotechnical ultimate bearing capacity of 3,000kPa.

For foundations bearing on competent fair to good quality schist bedrock a working bearing stress of 2,000kPa is recommended for a 300mm wide by 300mm deep footing. This corresponds to a factored (ULS) bearing capacity of approximately 3,000kPa and a geotechnical ultimate bearing capacity of 6,000kPa.

7.3.2.2 Foundations on Alluvial Fan Deposits

Figure 7.1 provides recommendations for foundation working stresses governed by bearing capacity (for narrow footings) or settlement (for wide footings) for foundations bearing on Alluvial Fan Deposits or Engineered Fill overlying Alluvial Fan Deposits.

Figure 7.1: Preliminary Recommendations for Working Stress of Footings bearing on Alluvial Fan Deposits or Engineered Fill overlying Alluvial Fan Deposits

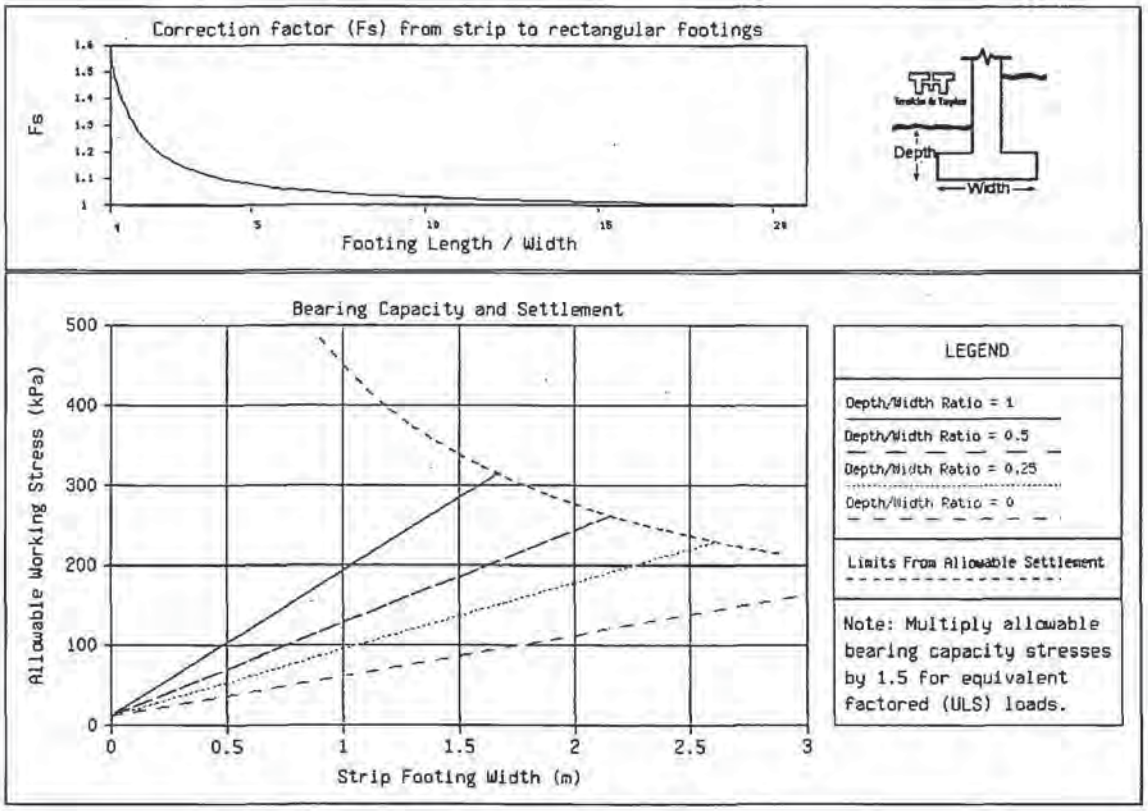
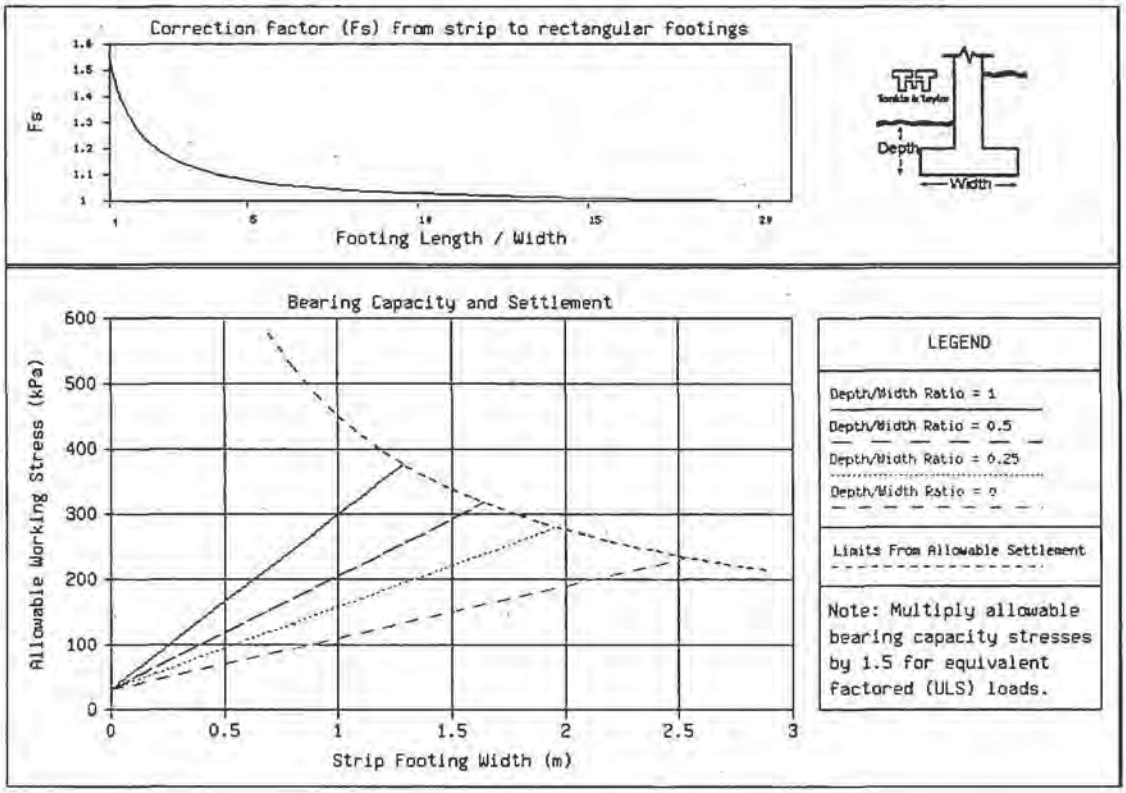


Figure 7.1 and 7.2 have been developed based on methods recommended by Peck Hanson and Thornburn (1974).

From Figure 7.1 it can be seen a working bearing stress of approximately 80 kPa is recommended for a 300mm wide by 400mm deep strip footing bearing on Alluvial Fan material or Engineered Fill overlying Alluvial Fan Deposits. This corresponds to a factored (ULS) bearing capacity of approximately 120kPa and a geotechnical ultimate bearing capacity of 240kPa.

Figure 7.2 provides recommendations for foundation working stresses governed by bearing capacity (for narrow footings) or settlement (for wide footings) for foundations bearing on River Gravels or Engineered Fill overlying River Gravels/Schist Bedrock.

Figure 7.2: Preliminary Recommendations for Working Stress of Footings bearing on River Gravels or Engineered Fill overlying River Gravels/Schist Bedrock



From Figure 7.2 it can be seen a working bearing stress of approximately 120kPa is recommended for a 400mm wide by 400mm deep strip footing bearing on River Gravels or Engineered Fill overlying River Gravels/Schist Bedrock. This corresponds to a factored (ULS) bearing capacity of approximately 180kPa and a geotechnical ultimate bearing capacity of 360kPa.

It is recommended that the prepared foundation sub-grade be inspected prior to the placement of concrete by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist to confirm the subgrade conditions are in accordance with the assumptions and recommendations provided in this report.

7.3.3 Foundation settlement

The issue of foundation settlement should be checked and confirmed during detailed design of the proposed foundations.

If the geotechnical design parameters recommended in this report are adopted for detailed design, settlement of shallow foundations bearing on rock is expected to be less than 5 to 10mm under normal in-service and ultimate seismic load conditions.

Settlement of shallow foundations bearing on soil is expected to be less than 25mm under normal in-service load conditions and less than 50mm under ultimate seismic load conditions.

7.4 Excavations and Retention

7.4.1 General

Preliminary recommendations for cut and fill earthworks batter angles, based on the interpreted stratigraphy and rock defects, are described in the following sections. Slopes that are required to be steeper than those described below should be structurally retained or subject to specific design by a Chartered Professional Engineer.

All slopes should be periodically monitored during construction for instability and excessive erosion, and, where necessary, corrective measures implemented to the approval of a suitably qualified chartered Professional Engineer or Engineering Geologist.

It is anticipated that any excavations which are undertaken as part of the proposed development will extend to a maximum depth of approximately 5 metres below the existing ground surface. Such excavations are expected to be formed within a combination of:

- Thinly bedded alluvial fan deposits;
- Fine grained, sub-horizontal laminated lake sediments;
- Colluvial material;
- River gravel material;
- Highly weathered, foliated, schist bedrock; and/or;
- Moderately to slightly weathered, foliated, schist bedrock.

The foliation of the schist shows a general trend of dipping 60 to 80° to the southwest (230 to 260°). Due to the preliminary nature of the subdivision concept plans that have been developed to date, no analysis or assessment has been made of the proposed excavations and how the schist foliation and joint defects will influence the cut excavation stability. This issue must be addressed as part of the detailed design work.

In areas where significant excavation into schist bedrock material is required, it is recommended that pilot cuts be made to allow detailed assessment of the rock defects and the design of rock support measures to be completed before the commencement of the bulk earthworks.

Rock support measures which may be required to achieve a satisfactory factor of safety against instability include retaining walls, shotcrete and/or rock anchors.

7.4.2 Temporary Cut Slopes in Soil and Rock

Table 7.1 provides preliminary recommendations for temporary cut slopes constructed in the soil and rock materials that have been identified on site.

Table 7.1: Preliminary Recommendations for Batter Slope Angles of Temporary Cut Slopes

Material Type	Maximum Slope Height (m)	Maximum Temporary Batter Slope in Dry Ground (horizontal to vertical)	Maximum Temporary Batter Slope in Wet Ground (horizontal to vertical)
Loose Alluvial Fan Deposits and Colluvial Deposits	5.0	1.5 : 1.0	3.0 : 1.0
Moderately dense Alluvial Fan Deposits, River Gravels, Lake Sediments and highly weathered Schist	5.0	1.0 : 1.0	2.0 : 1.0
Moderately weathered Schist	5.0	0.25:1.0 (See Note 1)	0.25:1.0 (See Note 1)

Note 1: Artificial support, such as props, rock bolts and/or shotcrete may be required in some locations to achieve a satisfactory factor of safety against instability.

All temporary cut slopes greater than 5.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified Geotechnical Engineer or Engineering Geologist who is familiar with the materials and the contents of this report.

If wet soils are encountered during excavation then drainage measures, such as horizontal drains, should be installed to the approval of a suitably qualified Geotechnical Engineer or Engineering Geologist. Particular note should be made of the presence of groundwater seepage at the soil-rock interface.

7.4.3 Permanent Cut Slopes in Soil and Rock

Table 7.2 provides preliminary recommendations for the batter angle of permanent cut slopes formed in soil and rock.

All permanent cut slopes greater than 5.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified Geotechnical Engineer or Engineering Geologist who is familiar with the materials and the contents of this report.

The stability of cut slopes in the schist bedrock is expected to be controlled by the pervasive foliation dipping out of slope, and the interaction between the slope, the foliation and the geometry of any joint sets.

Batters of 0.25:1.0 (H:V) are likely to be appropriate in competent defect-free schist for unsupported cuts to excavation depth. Stability will need to be assessed with progressive inspection of staged cuts or pilot cuts during excavation, and the need for artificial support such as rock bolts/shotcrete confirmed on site.

Table 7.2: Preliminary Recommendations for Permanent Cut Slope Batter Angles in Soil and Rock

Material Type	Maximum Recommended Batter Angle in Permanent Cut Slopes Less than 5.0 Metres High (horizontal to vertical)	Maximum Recommended Batter Angle in Permanent Cut Slopes Greater than 5.0 Metres High (horizontal to vertical)
Loose Alluvial Fan Deposits and Colluvial Deposits	3.0 : 1.0	Specific Design to be Completed
Moderately dense Alluvial Fan Deposits, River Gravels, Lake Sediments and Highly Weathered Schist	2.0 : 1.0	Specific Design to be Completed
Moderately Weathered Schist	0.25:1.0 (See Note 1)	0.25:1.0 (See Note 1)

Note 1: Artificial support, such as props, rock bolts and/or shotcrete may be required in some locations to achieve a satisfactory factor of safety against instability.

If wet soils are encountered during excavation then drainage measures, such as horizontal drains, should be installed to the approval of a suitably qualified Geotechnical Engineer or Engineering Geologist. Particular note should be made of the presence of groundwater seepage at the soil-rock interface.

7.4.4 Fill Slopes

All fill should be placed and compacted in accordance with NZS4431:1989 and certified in accordance with Queenstown Lakes District Council standards.

Table 7.3 provides preliminary recommendations for the batter angle of fill slopes that are formed in Engineered Fill.

Table 7.3 Preliminary Recommendations for Batter Slope Angles in Engineered Fill

Material Source	Maximum Recommended Batter Angle for Engineered Fill Slopes Less than 3.0 Metres High (horizontal to vertical)	Maximum Recommended Batter Angle for Engineered Fill Slopes Greater than 3.0 Metres High (horizontal to vertical)
River Gravels, Lake Sediments and highly weathered Schist	2.0 : 1.0	Specific Design to be Completed
Alluvial Fan Deposits, and Blended Materials	2.5 : 1.0	Specific Design to be Completed

All fill slopes which are greater than 3.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified geotechnical engineer or engineering geologist who is familiar with the on site materials and the contents of this report.

7.4.5 Retaining walls

All retaining walls should be designed by a Chartered Professional Engineer with due allowance made for issues such as traffic surcharge, sloping ground surfaces upslope and down slope of the retaining walls and groundwater pressures. Appropriate drainage measures should be provided behind all retaining structures to control potential groundwater pressures.

Groundwater seepage may be present at the interface between the overlying soils and the underling schist bedrock. Additional drainage measures, such as horizontal drains, should be incorporated into the retaining wall design if they are expected to intersect the schist bedrock surface.

Horizontal drains may also need to be constructed in some locations to control excessive groundwater seepage or flows in the retained ground. A heavy-duty perforated pipe should be installed within the drainage gravel at a level below any adjacent floor slabs to minimise the risk of excessive groundwater pressure behind and groundwater seepage through the completed retaining walls.

All retaining wall backfill should comprise compacted, Engineer-approved, durable, free-draining gravel. Comprehensive waterproofing measures should be provided to the back of all retaining walls to control and minimise groundwater seepage into the finished building.

All retaining wall soil loads should be estimated using the geotechnical parameters presented in Section 6 of this report.

Due allowance should be made during the design of all retaining walls for issues such as traffic surcharge and any sloping ground surfaces behind and in front of the retaining walls.

7.5 Groundwater Issues

It is likely that perched groundwater flows will occur in some locations at the Schist bedrock surface, from some defects within the schist, and at the contact between soil layers of different permeability, particularly during and after periods of prolonged or heavy rainfall.

Measures to control potential groundwater flows should be broadly designed prior to the commencement of construction. Subsoil drainage measures, where required, should be confirmed on site based on site observations and are expected to comprise horizontal drains.

7.6 Stability of the Existing Slopes

An engineering geological survey and visual assessment of the slopes within and adjacent to the site has been completed as part of the site investigation works. A number of areas of historic, recent and ongoing slope instability were noted on site during this assessment.

Detailed discussion regarding the hazards posed to the proposed development by the areas of unstable land is presented in the Natural Hazards Section of this report. A short summary of that section is contained here.

A large area of hummocky land, thought to be the inactive Resta Road landslide, is located upslope of a large part of the proposed development. While this landslide is not thought to pose a high risk to the proposed development, several areas of recent and ongoing instability were noted on the steep terrace face immediately upslope of much of the proposed development that is located south of SH6. This area of active instability coincides with the inferred toe of the Resta Road Slide and a number of active groundwater springs.

Ongoing movement of one or a number of these recent and/or active landslides, or activation of additional failures, poses a potential hazard and risk to parts of the proposed development. Engineered solutions that are available to minimise the risk this hazard include promoting vegetation, installing drainage and constructing debris bunds and/or shear keys. Stipulating a minimum building setback distance from the base of steep unstable slopes also decreases the risk to the proposed development.

There is also a risk of minor instability in the form of rock falls and rock topples to the areas down-slope from the moderately steep to steep slopes and where bedrock is exposed at the ground surface. Engineered solutions are available to reduce the risk this hazard poses to the proposed development to a satisfactory level.

7.7 Subsoil Class for Seismic Design

For preliminary design purposes it is recommended all structures be designed to tolerate seismic loads in accordance with the recommendations of NZS 1170.0:2002 and the magnitude of seismic acceleration be estimated in accordance with the recommendations of NZS 1170.5:2004.

Most of the proposed buildings are expected to be constructed in areas where there is more than 3 metres of soil overlying Schist bedrock. As such it is recommended all building sites be categorised as a Shallow Soil site (site subsoil Class C) in relation to NZS 1170.5:2004, Cl 4.6.2.2 seismic provisions.

The subsoil conditions for seismic design should be reviewed and confirmed on a case-by-case basis once the design and location of all proposed buildings have been finalised.

During a seismic event variable ground accelerations may occur across structures which are constructed over a combination of rock and soil, in particular if the thickness of underlying soil exceeds 3 to 4 metres. This issue should be assessed during detailed design of the building foundations.

7.8 Pavements

Table 7.4 provides recommendations for the in-situ 10 percentile CBR value that is recommended for preliminary design of the proposed road and accessway pavements.

Table 7.4: Recommended Subgrade 10 Percentile CBR Values for Preliminary Pavement Design

Sub-grade	Recommended 10 Percentile CBR Value
Loose Alluvial Fan Deposits and Colluvial Deposits	2%
Moderately dense Alluvial Fan Deposits, River Gravels, Lake Sediments and Highly Weathered Schist	6%
Unweathered Schist	15+%
Certified Engineered Fill	10%

Groundwater is not expected to adversely affect the proposed road pavement; however, suitable sub-soil drainage measures should be incorporated into the pavement design if the subgrade comprises silt dominant soils.

Topsoil was present across most of the site to a maximum depth of 2.1 m and an average depth of 0.4 m. All topsoil and unsuitable materials should be removed from beneath the road footprints prior to commencing pavement construction.

7.9 Existing Structures and Neighbouring Properties

The proposed development is not located adjacent to any existing structure and is not expected to adversely affect the neighbouring properties.

7.10 Aquifers

No aquifer resource is expected to be adversely affected by the proposed development.

7.11 Environmental Issues during Construction

7.11.1 Erosion and Sediment Control

Effective systems for erosion control are run-off diversion and contour drains, and sediment control options are earth bunds, silt fences, hay bales, vegetation buffer strips and sediment ponds.

The least amount of subsurface materials should be exposed at any stage of the construction and vegetation re-established as soon as possible or mulch applied.

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/

7.11.2 Noise

It is expected that conventional earthmoving equipment such a bulldozers, excavators, trucks and rock breakers, will be used during the earthworks construction.

Construction noise is not expected to be an issue due to the distance to neighbouring properties.

7.11.3 Dust

The sub-surface soils on site may present a potential to generate dust. Regular damping with sprinklers should be effective to prevent airborne dust during the construction.

8 Conclusions and Recommendations

Proposed Development

- From a geotechnical perspective, T&T considers the proposed Gibbston Valley Station development is technically feasible; however, detailed design of the proposed foundations, cut slopes, earthworks, retaining walls and engineering solutions for management of the natural hazards must be completed as part of the detailed design phase of the project.
- The natural hazard risks are considered acceptable providing appropriate investigation, assessment and design of works to manage the natural hazard risks are completed as part of the detailed design phase of the project.

Existing Geotechnical Conditions

- The site is primarily located on River Gravel terraces, however, a large fluvial-glacial outwash gravel terrace dominates the southern part of the site.
- Much of the proposed development is located on the south side of SH6 upon gently sloping land at the base of a moderately steep to steep slope. This steep slope defines the edge of the fluvial-glacial outwash gravel terrace.
- Additional development is proposed on the north side of SH6. These sites generally comprise gently sloping to moderately steeply sloping land adjacent to outcropping Schist bedrock and the crest of the Kawarau River gorge bluffs.
- The stratigraphy of the site typically comprises:
  - A thin layer of topsoil, overlying,
  - Silty sandy Alluvial Fan deposits, overlying,
  - River Gravel deposits, overlying,
  - Schist bedrock.

  Isolated layers of colluvium and lake sediment materials are also present in some areas of the site.

  Figures 2a to 2p in Appendix A of this report present geological cross-sections through the site and summarise the interpreted sub-surface stratigraphy. The locations of the geological cross-sections are shown on Figures 1b and 1c in Appendix B.
- Generally the thickness of soil overlying bedrock decreases towards the edge of the Kawarau River gorge. Schist bedrock outcrops were observed over much of the site that occupies the northern side of SH6.
- The greatest thickness of Alluvial Fan and River Gravel Deposits were encountered on the south side of SH6. Bedrock was not identified in any of the test pit excavations which were located on south of SH6.
- The foliation of the Schist was observed to dip at an angle between 56 and 81° (dip) towards bearing 230 to 260° (dip direction)
- Perched groundwater seeps and springs may be encountered in some locations at the Schist bedrock surface and in overlying soils at interfaces between more permeable and less permeable soils.

A single test pit excavation encountered water inflow at 2.1 m depth. This was inferred to be a perched water table and is not thought to be representative of the regional groundwater table.

- The regional groundwater table is expected to lie within the schist bedrock at some considerable depth below the existing ground surface.
- A large area of land upslope and south of the main area of the proposed development has previously been identified as the inactive Resta Road Slide. The inferred toe of the Resta Road Slide lies within the fluvial glacial outwash gravel terrace face and corresponds with areas of moderate to small scale recent and ongoing instability and springs.

Natural Hazards

- Several natural hazards that could potentially affect the proposed development were identified during the site walkover survey.
- Active areas of small sized slope instability were identified on the terrace face which is located immediately upslope of much of the proposed development. There is a risk that reactivation of a historic landslide, or ongoing movement of an active landslide, or mobilization of a new landslide feature may affect the proposed development. Set back distances from the toe of unstable slopes and/or stabilization measures such as subsoil drainage and/or shear keys may be constructed to manage the landslide hazard.
- Many of the steeper terrace faces and incised gully slopes show evidence of surficial erosion, as do the areas at the top of the Kawarau River gorge bluffs in the northern part of the site. Erosion is a potential hazard to the proposed development as regression of the crest of steep slopes and bluffs could undermine buildings and structures and also cause accessibility issues. The eerosion hazard can be managed by the control of surface and storm water flows and by the planting of appropriate ground cover.
- Moderate to large sized schist rocks and boulders were observed on and/or near to the ground surface in various locations across the site. Rock toppling has also been identified as a potential natural hazard in those parts of the site which lie below steep schist rock bluff. Options to manage the rock roll and rock toppling hazard include rock fall run out zones, building setback areas and debris detention devices such as engineered earth bunds and catch fences.
- Flooding of the Kawarau River is highly unlikely to affect the proposed development, however, flooding of the smaller streams that cross the site, and associated debris flows, may affect the proposed development. Flood and debris flow mitigation measures can be constructed to reduce this hazard. Such measures include designation of flood paths, building setback lines, construction of drainage channels and debris diversion structures.
- Earthquake fault rupture and ground shaking hazards exist from the Nevis or Cardrona Faults which run through the north-western corner of the site, or rupture of a more distant fault line, such as the Alpine Fault which is located along the West Coast of the South Island.

  Rupture of the Nevis Fault would cause significant damage to structures which lie over or close to the surface expression of the rupture. Where possible the surficial

trace of any fault lines should be identified on site and building set back lines developed to manage this hazard.

All structures should be designed to tolerate seismic loads in accordance with the recommendations of the appropriate New Zealand codes and standards.

- Based on the site observations which have been made to date, the risk of widespread liquefaction is assessed to be very low to nil. However, the liquefaction risk should be assessed and confirmed on a site by site basis when the final layout and design of the individual proposed buildings is finalised.

Geotechnical Design Parameters

- Geotechnical design parameters for preliminary design purposes are presented in Table 6.1 of this report.

Earthworks Construction

- All fill should be placed and compacted in accordance with NZS4431:1989 and certified in accordance with Queenstown Lakes District Council standards.
- The alluvial fan deposits and river gravel deposits are considered suitable for use as engineered fill.
- The colluvium, lake sediment and existing fill deposits are considered unsuitable for use as engineered fill. It is recommended these materials be used as non-structural landscaping fill, be blended with river gravel materials, or be removed from site. Due allowance for this should be made in the construction budget and programme.
- All topsoil, residual topsoil, organic matter, colluvial deposits and other unsuitable materials should be removed during earthworks construction in accordance with the recommendations provided in NZS 4431:1989.
- All bulk excavations should be left proud of the finished subgrade level by 200 to 300mm. The final cut to grade should be performed immediately prior to topsoil placement and seeding, pavement construction or retaining wall construction.
- Covering of the soils with polythene sheeting will reduce degradation due to rain infiltration and surface run-off.
- Under no circumstances should water be allowed to pond or collect near or under a foundation slab, road pavement or retaining wall footprint.
- Robust, shallow graded sediment control measures should be instigated prior to commencing earthworks construction.

Building Foundations

- The design of all foundations should be reviewed by a Geotechnical Chartered Professional Engineer once the location, extent and design of all proposed buildings has been finalised.
- Shallow foundations are recommended in those areas where the building platform sub-grade comprises Schist rock, flat to gently sloping alluvial fan deposits, river gravel deposits or Engineered Fill that has been constructed over alluvial fan deposits, river gravel deposits and/or Schist rock.

- Recommendations for the working bearing pressures of shallow foundations constructed on alluvial fan deposits or engineered fill placed over alluvial fan deposits are presented in Figure 7.1 of this report.
- Recommendations for the working bearing pressures of shallow foundations constructed on river gravel deposits or engineered fill placed over river gravel deposits or Schist bedrock are presented in Figure 7.2 of this report.
- For foundations bearing on poor quality schist rock a working bearing stress of 1,000 kPa is recommended for a 300mm wide by 300mm deep footing.
- For foundations bearing on competent fair to good quality schist rock a working bearing stress of 2,000kPa is recommended for a 300mm wide by 300mm deep footing.
- The issue of foundation settlement should be checked and confirmed during detailed design of the proposed foundations.
- If the design parameter recommendations of this report are followed, settlement of shallow foundations bearing on rock is expected to be less than 5 to 10mm under normal in-service and ultimate seismic load conditions.
- If the design parameter recommendations of this report are followed, settlement of shallow foundations bearing on soil is expected to be less than 25mm under normal in-service load conditions and less than 50mm under ultimate seismic load conditions.
- In order to minimise the risk of groundwater seepage into the finished building basement, a 100mm minimum thickness of free draining granular fill and a network of subsoil drainage pipes should be constructed beneath the ground level and basement floor slabs. The outlet of all foundation slab drains should be connected to the permanent piped stormwater system.
- All foundation subgrade should be inspected by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations presented in this report.

Artificial Slopes

- Recommended batter angles for temporary slopes cut in natural soil and competent schist rock are presented in Table 7.1 of this report.
- All temporary cut slopes greater than 5.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified geotechnical engineer or engineering geologist who is familiar with the materials and the contents of this report
- Preliminary recommendations for permanent slope batter angles are presented in Table 7.2 of this report.
- All permanent cut slopes greater than 5.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified Geotechnical Engineer or Engineering Geologist who is familiar with the materials and the contents of this report.
- Recommended batter angles for slopes formed in engineered fill materials are presented in Table 7.3 of this report.
- All engineered fill slopes greater than 3.0 metres high must have specific stability analysis and engineering design carried out by a suitably qualified Geotechnical

Engineer or Engineering Geologist who is familiar with the materials and the contents of this report.

- Drainage measures such as horizontal drains should be installed to the approval of a suitably qualified Geotechnical Engineer or Engineering Geologist if the as-built cut slopes are found to comprise wet materials.
- All artificial slopes should be periodically inspected during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations of this report.

Retaining Walls

- All retaining walls should be designed by a Chartered Professional Engineer.
- Recommended geotechnical parameters for the preliminary design of retaining walls are presented in Table 6.1 of this report.
- Due allowance should be made during detailed design of all retaining walls for issues such as traffic surcharge and sloping ground surfaces behind and in front of the retaining walls.
- Appropriate drainage measures should be provided behind all retaining walls to control groundwater pressures. Horizontal drains may also be required to control groundwater flows that are associated with perched groundwater tables or defects in the Schist rock. The outlet of all horizontal drains should be connected to the permanent piped storm water system.
- The construction of all retaining walls should be periodically inspected by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations presented in this report.

Seismic Design

- A risk of seismic activity has been identified for the region as a whole and provision should be made for seismic loads during the detailed design of all proposed structures.
- For preliminary design purposes it is recommended the magnitude of seismic acceleration be estimated in accordance with the recommendations of NZS 1170.5:2004 assuming Class C subsoil conditions are present at all locations on site.
- The seismic sub-soil class should be revisited and confirmed once the location, extent and design of each building has been confirmed.

Pavement Design

- Recommended in-situ design (10 percentile) CBR values for pavement design are presented in Table 7.4 of this report.
- Groundwater is not expected to adversely affect the proposed road pavement, however, suitable sub-soil drainage measures should be incorporated into the pavement design if the subgrade comprises silt materials.

- All topsoil and unsuitable materials should be removed from beneath the road footprint prior to commencing pavement construction.

Geotechnical Issues to be Addressed during the Detailed Investigation and Design Phase of the Project

- Detailed investigation, analysis and design of the permanent slopes.
- Detailed investigation, analysis and design of the temporary and permanent slopes that are to be cut in Schist rock including design of all necessary stabilisation works such as rock bolts and shotcrete.
- Detailed investigation and design of any temporary and permanent retaining walls.
- Detailed investigation and assessment of the geotechnical stability of the building platforms.
- Detailed review and assessment of the seismic subsoil class and seismic acceleration for each building platform.
- Detailed investigation and review of the proposed foundations including assessment of foundation settlement.
- Detailed review of the proposed building platform construction sequence and construction methodology.
- Testing and certification of engineered fill in accordance with the requirements of NZS 4431:1989 and Queenstown Lakes District Council Standards.
- Inspection of all earthworks, retaining wall and foundation construction by a suitably qualified and experienced engineer or engineering geologist who is familiar with the contents of this report.

9 Applicability

This report has been prepared for the benefit of Gibbston Valley Station Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor by:
.....	.....
Shamus Wallace	Anthony Fairclough
Engineering Geologist	Senior Geotechnical Engineer

scww

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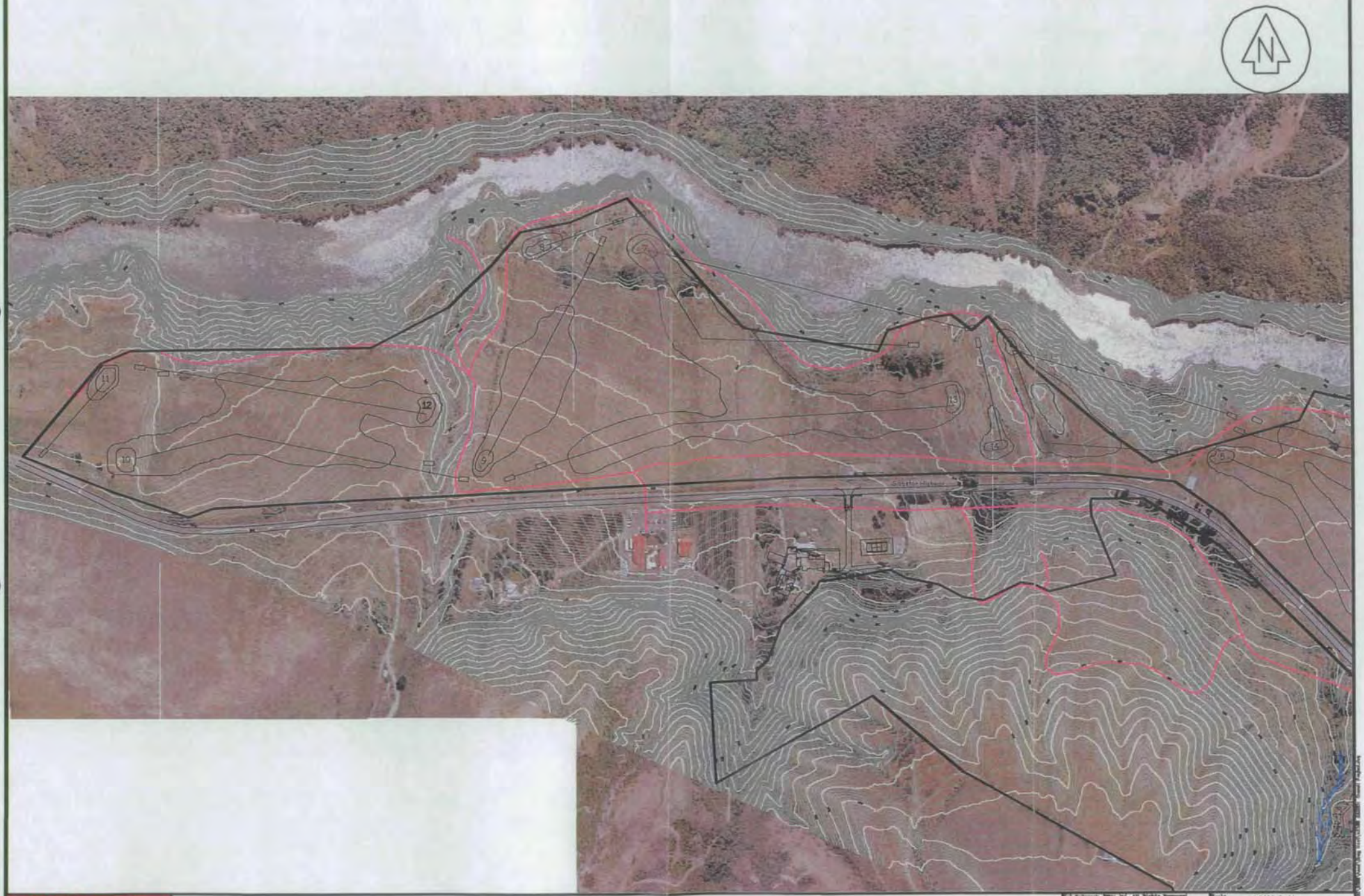
Appendix A: Development Plans

- **Patterson Pitts Ltd. plan titled Gibbston Valley Station 1 Feb 2008, (preliminary western development plan)**
- **Patterson Pitts Ltd. plan titled Gibbston Valley Station 1 Feb 2008, (preliminary eastern development plan)**
- **Patterson Pitts Ltd. plan titled Central Area Gibbston Valley Station dated 24/10/2007, (preferred eastern development locations)**

PATERSON PITTS LTD

Gibbston Valley Station 1st Feb. 2008



Gibbston Valley Station 1st Feb. 2008

PATERSON PITTS LTD

Central Area
Gibbson Valley Station

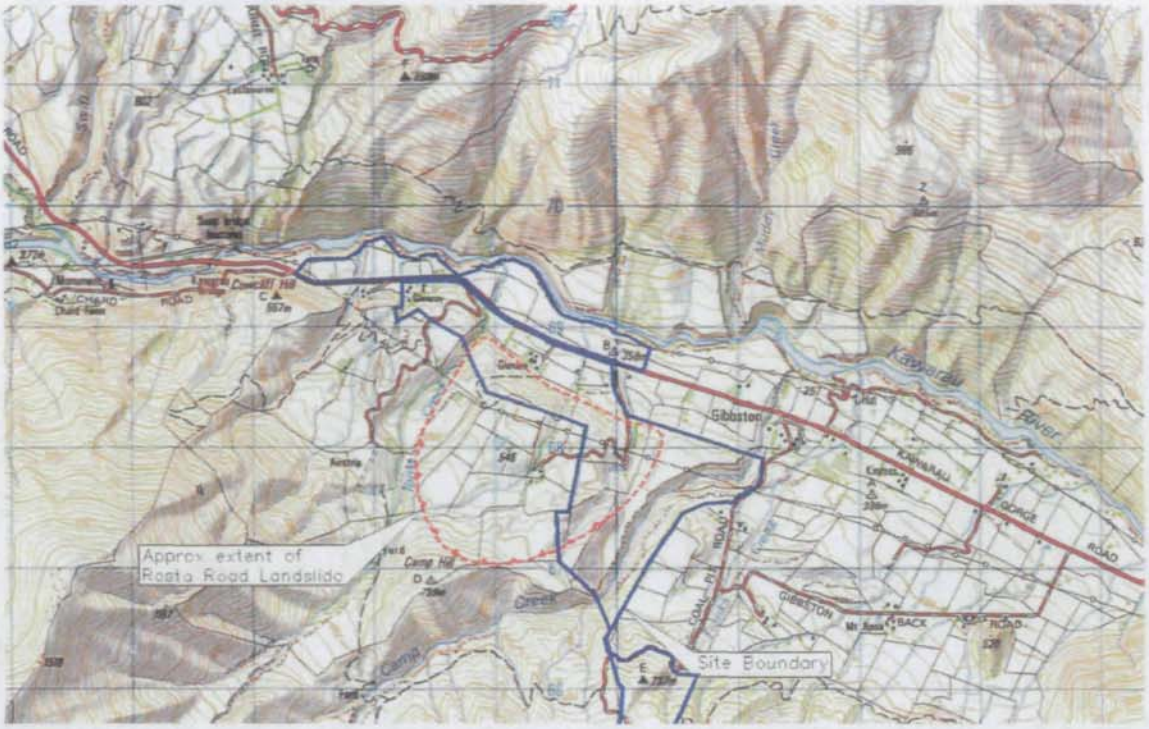
Notes
Areas & dimensions subject to final survey
Levels in terms of Mean Sea Level

Scale 1:750 @ A1
Drawn By NR
Date 24/10/2007
Job No. 11xxxxx

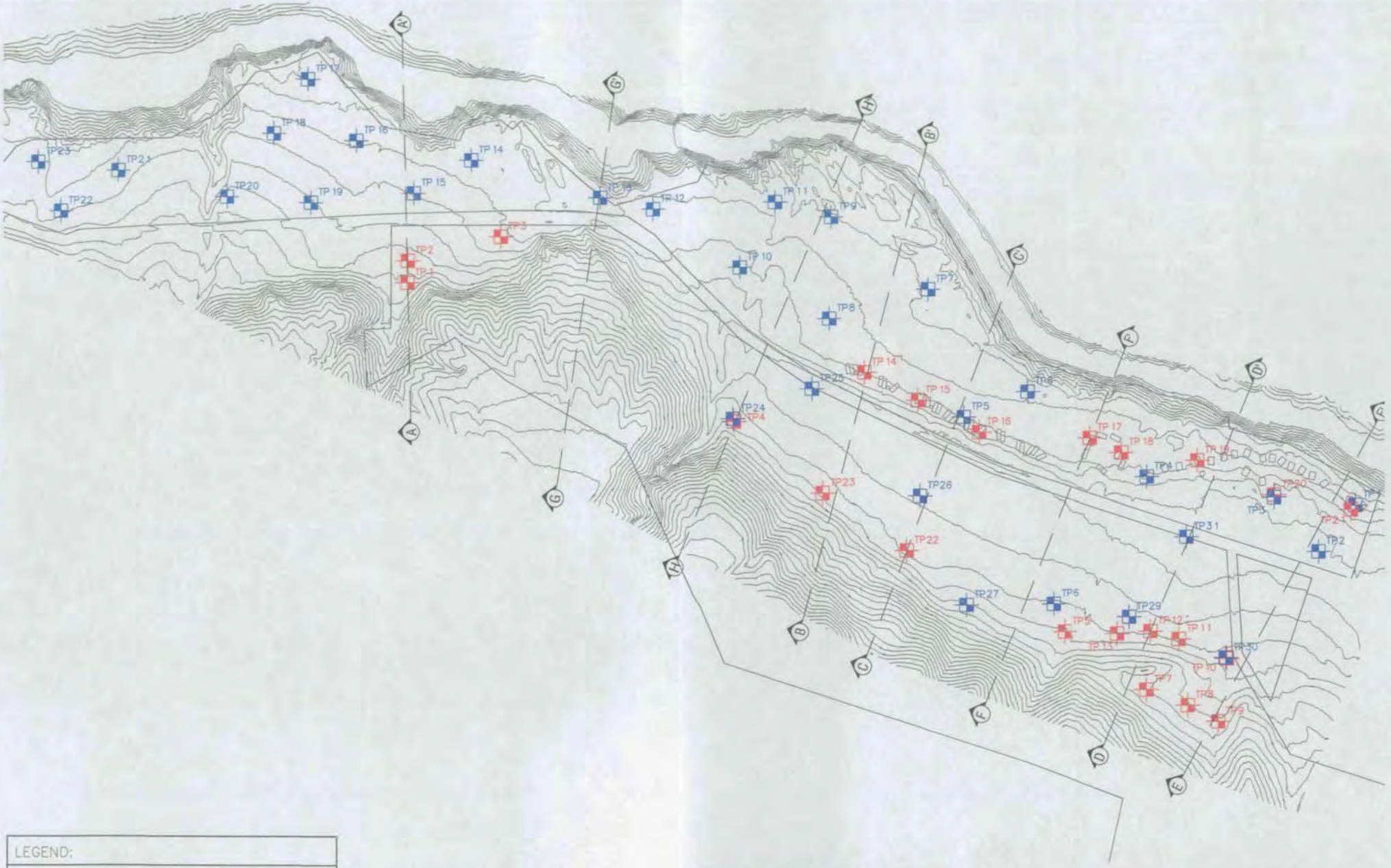
Appendix B: Geotechnical Investigation Plans

- **Figure 1a: Site Location Plan**
- **Figure 1b: Test Pit Investigation Plan**
- **Figure 1c: Engineering Geological Site Plan**
- **Figures 2a and 2b: Cross Section A-A'**
- **Figures 2c and 2d: Cross Section B-B'**
- **Figures 2e and 2f: Cross Section C-C'**
- **Figures 2g and 2h: Cross Section D-D'**
- **Figures 2i and 2j: Cross Section E-E'**
- **Figures 2k and 2l: Cross Section F-F'**
- **Figures 2m and 2n: Cross Section G-G'**
- **Figures 2o and 2p: Cross Section H-H'**

Figure 1a: Site location



Base map from 1:50 000 MapToaster series.



LEGEND:

- TP1 — TONKIN & TAYLOR TEST PIT LOCATION
- TP1 — DUFFILL WATTS TEST PIT LOCATION

SCALE 1:7500

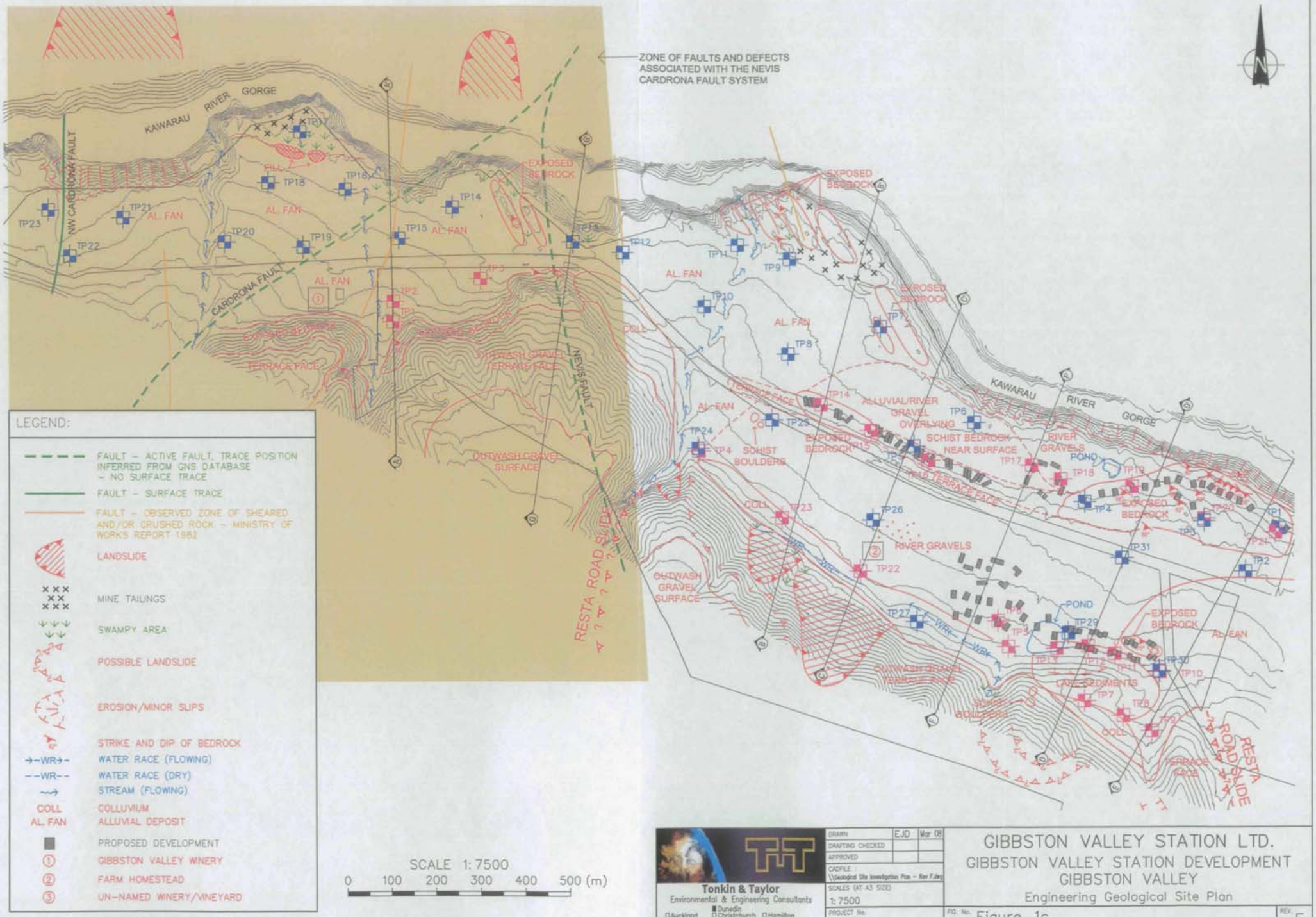
0 100 200 300 400 500 (m)

Tonkin & Taylor
Environmental & Engineering Consultants
Dunedin
Auckland Christchurch Hamilton
Nelson Wellington Tauranga

DRAWN	EJD	MAR 08
DRAFTING CHECKED		
APPROVED		
CADFILE : \\Test Pit Location Plan – Rev d.dwg		
SCALES (AT A3 SIZE)	1:7500	
PROJECT No.	880063	

GIBBSTON VALLEY STATION LTD.
GIBBSTON VALLEY STATION DEVELOPMENT
GIBBSTON VALLEY
Test Pit Investigation Plan

FIG. No. Figure 1b REV. D



Tonkin & Taylor
Environmental & Engineering Consultants
Auckland Dunedin Christchurch Hamilton
Nelson Wellington Tauranga

DRAWN	EJD	Mar 08
DRAFTING CHECKED		
APPROVED		
CADFILE :	\\Geological Site Investigation Plan - Rev F.dwg	
SCALES (AT A3 SIZE)	1: 7500	
PROJECT No.	880063	

GIBBSTON VALLEY STATION LTD.

GIBBSTON VALLEY STATION DEVELOPMENT
GIBBSTON VALLEY

Engineering Geological Site Plan

FIG. No. Figure 1c

REV. F

Appendix C: Investigation Logs

- **Tonkin and Taylor test pit excavation logs**
- **DWK test pit excavation logs**

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 1**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope <5°

EASTING:	2188268 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5569268 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	366 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2		Grey blue, silty sandy GRAVEL. Gravel is fine to coarse. Platey rounded schist clasts. Non plastic, non dilatant. Medium dense to dense. Bedding layers are sub-parallel to ground. Total Depth = 3.1 m	Dry	ALLUVIAL FAN DEPOSIT

COMMENT: Test pit excavated at the base of an existing 3.5m cut. Cut exposes at 1.5m, platey schist GRAVEL with some sand overlying and at 2.5m, silty GRAVEL as above.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 2**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope <5°

EASTING:	2188269 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5569314 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	365 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2		Grey blue, silty sandy GRAVEL. Gravel is fine to coarse. Platey rounded schist clasts. Non plastic, non dilatant. Medium dense to dense. Bedding layers are sub parallel to ground. 20-100mm alternating layers of sand and gravel. Total Depth = 3.1 m	Dry	ALLUVIAL FAN DEPOSIT

COMMENT: Test pit excavated at the base of an existing 1.5m cut exposing GRAVEL as above.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 3**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope <5°

EASTING:	2188465 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5569365 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	352 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Black brown, organic SILT with rootlets. Slightly plastic, Firm. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6				
		0.8		Dark brown, micaeous SILT with minor gravel and minor rootlets. Gravel is fine. Slightly plastic. Stiff to soft. Pocket penetrometer @ 0.8m is 250kPa and at 1.8m <50kPa. Homogeneous.	Moist	REMNANT TOPSOIL
		1.0				
		1.2				
		1.4				
		1.6				
	▽Groundwater @ 2.1 m	1.8				
		2.0				
		2.2		Grey, silty sandy GRAVEL. Gravel is fine and rounded. Platey rounded schist clasts. Non plastic, non dilatant. Medium dense.	Wet	ALLUVIAL FAN DEPOSIT
		2.4				
		2.6		Total Depth = 2.5 m		
		2.8				
		3.0				
		3.2				

COMMENT: Water inflow prevented further excavation.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6		Brown, silty sandy GRAVEL. Sand is coarse to very coarse. Platey sub-rounded gravels. Well graded. Non plastic, non dilatant. Loose to medium dense. Bedding layers are sub parallel to ground.	Moist	ALLUVIAL FAN DEPOSIT
		0.8				
		1.0				
		1.2				
		1.4		Grey brown, sandy GRAVEL. Sand is coarse. Gravel is fine and rounded. Poorly graded. Non plastic, non dilatant. Loose. Bedding layers are sub parallel to ground.	Moist	ALLUVIAL FAN DEPOSIT
		1.6		Brown, silty sandy GRAVEL. Gravel is fine to coarse. Platey rounded schist clasts. Well graded. Non plastic, non dilatant. Medium dense. Bedding layers are sub parallel to ground.	Moist	ALLUVIAL FAN DEPOSIT
		1.8				
		2.0		Light brown, sandy GRAVEL. Sand is fine to coarse. Platey sub-rounded schist gravels. Poorly graded. Non plastic, non dilatant. Medium dense. 100mm beds. Bedded parallel to slope.	Dry	ALLUVIAL FAN DEPOSIT
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
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Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, sandy GRAVEL. Sand is fine to coarse. Platey sub-rounded schist gravels. Poorly graded. Non plastic, non dilatant. Medium dense. 100mm beds. Bedded parallel to slope.	Dry	ALLUVIAL FAN DEPOSIT
		3.6				
				Total Depth = 3.6 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets and minor gravel. Gravel is fine. Slightly plastic. Firm. Bedded parallel to slope.	Moist	TOPSOIL
		0.4				
		0.6		Black, organic SILT with minor gravel and minor rootlets. Gravel is fine. Slightly plastic. Stiff to very stiff. Bedded parallel to slope.	Moist	REMNANT TOPSOIL
		0.8		Dark brown, sandy, slightly organic micaeous SILT with minor gravel and minor rootlets. Gravel is fine. Well graded. Slightly plastic. Firm. Bedded parallel to slope.	Moist	REMNANT TOPSOIL
		1.0				
		1.2		Light brown, silty sandy GRAVEL. Gravel is fine to coarse. Platey rounded schist clasts. Gap graded. Non plastic, non dilatant. Loose to medium dense. Bedded parallel to slope.	Dry	ALLUVIAL FAN DEPOSIT
		1.4				
		1.6		Light brown, sandy GRAVEL with some silt. Gravel is fine to coarse, angular, and increasing in size with depth. Well graded. Non plastic, non dilatant. Medium dense to dense. Bedded dip 10° into slope (towards 166°).	Dry	RIVER GRAVELS
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, sandy GRAVEL with some silt. Gravel is fine to coarse, angular, and increasing in size with depth. Well graded. Non plastic, non dilatant. Medium dense to dense. Bedded dip 10° into slope (towards 166°).	Dry	RIVER GRAVELS
				Total Depth = 3.4 m		
		3.6				
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 6**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 0°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, sandy SILT with minor gravel. Gravel is fine to medium. Stiff. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6		Black, organic SILT with rootlets, minor sand and gravel. Sand is medium to coarse. Gravel is fine. Non plastic, non dilatant. Firm. Homogeneous.	Moist	BURIED TOPSOIL
		0.8		Dark brown, micaeous SILT with minor gravel, rootlets and sand. Sand is coarse, gravel is fine. Slightly plastic. Very stiff. Homogeneous.	Moist	REMNANT TOPSOIL
		1.0		Light brown/grey, silty GRAVEL with sand. Sand is medium to coarse. Sub-rounded schist gravel is fine to very coarse. Well graded. Non plastic. Medium dense to dense. Bedded parallel to surface.	Dry	RIVER GRAVELS
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
		2.2		Light brown, sandy GRAVEL with minor silt. Gravel clasts are fine to medium. Poorly graded. Non plastic. Medium dense. Homogeneous.	Dry	RIVER GRAVELS
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER:
TP 6

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: n/a

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, sandy GRAVEL with minor silt. Gravel clasts are fine to medium. Poorly graded. Non plastic. Medium dense. Homogeneous.	Dry	RIVER GRAVELS
		3.6				
		3.8				
				Total Depth = 3.8 m		
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
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Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 7**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	2189808 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568412 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	395 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Brown, silty GRAVEL with sand. Sand is coarse, gravel is fine to medium, platey and sub-rounded. Non plastic. Loose to medium dense. Homogeneous.	Moist	COLLUVIUM
		0.6				
		0.8				
		1.0				
		1.2				
		1.4		Light brown, silty sandy GRAVEL. Gravel is coarse to very coarse, platey and sub-rounded. Well graded. Non plastic, non dilatant. Medium dense to dense. Homogeneous.	Dry	ALLUVIAL FAN DEPOSIT
		1.6				
		1.8				
		2.0				
		2.2		Light brown, silty sandy GRAVEL with boulders. Occasional angular to sub-rounded boulders. Gap graded. Non plastic, non dilatant. Medium dense to dense. Homogeneous.	Dry	ALLUVIAL FAN DEPOSIT
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 7**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 10°

EASTING:	2189808 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568412 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	395 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, silty sandy GRAVEL with boulders. Occasional angular to sub-rounded boulders. Gap graded. Non plastic, non dilatant. Medium dense to dense. Homogeneous.	Dry	ALLUVIAL FAN DEPOSIT
		3.6		Total Depth = 3.5 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	2189894 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568379 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	389 m	DIMENSIONS: .	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Brown, silty GRAVEL. Gravel is fine and rounded with occasional large platey schist clasts. Well graded. Non plastic, non dilatant. Medium dense. Bedding layers are sub parallel to ground.	Moist	ALLUVIAL FAN DEPOSIT
		0.6				
		0.8				
		1.0				
		1.2		Light brown, sandy GRAVEL with minor silt. Fine to coarse sand matrix with some silt. Coarse platey gravels with lenses of fine gravels and sands. Well graded. Non plastic. Medium dense to dense. Bedded parallel to slope.	Dry	ALLUVIAL FAN DEPOSIT
		1.4				
		1.6				
		1.8		Light brown, sandy SILT. Laminated micaeous silts and fine sands. Non plastic, slightly dilatant. Stiff to very stiff. Pocket penetrometer @ 2.0m is 200kPa. Laminated to very thin bedding.	Dry	LAKE SEDIMENTS
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	2189894 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568379 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	389 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, sandy SILT. Laminated micaeous silts and fine sands. Non plastic, slightly dilatant. Stiff to very stiff. Pocket penetrometer @ 2.0m is 200kPa. Laminated to very thin bedding.	Dry	LAKE SEDIMENTS
		3.6		Total Depth = 3.6 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 7°

EASTING:	2189957 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568345 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	391 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Black brown, organic SILT with rootlets. Slightly plastic. Firm to stiff. Homogeneous.	Moist	TOPSOIL
		0.4		Brown, sandy gravelly SILT. Sand is medium to coarse. Gravel is fine, rounded in layers in silt. Non plastic. Silt is stiff to very stiff. Gravel is loose to medium dense. Pocket penetrometer @0.8 - 1.0m is 150 - 250Kpa. Horizontally interbedded.	Moist	ALLUVIAL FAN DEPOSIT
		0.6				
		0.8				
		1.0				
		1.2				
		1.4		Brown grey, silty sandy GRAVEL. Sand is fine to coarse, gravel is fine to medium and rounded. Lenses of silt and sand. Non plastic. Medium dense to dense. Horizontally interbedded.	Moist to dry	ALLUVIAL FAN DEPOSIT
		1.6		Brown grey, silty sandy GRAVEL. Gravel is medium to coarse, rounded to sub-rounded and platey. Non plastic. Dense. Massive.	Dry	RIVER GRAVELS
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 7°

EASTING:	2189957 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568345 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	391 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Brown grey, silty sandy GRAVEL. Gravel is medium to coarse, rounded to sub-rounded and platey. Non plastic. Dense. Massive.	Dry	RIVER GRAVELS
		3.6		Total Depth = 3.5 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope <5°

EASTING:	2189975 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568477 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Dark brown, silty sandy GRAVEL. Sand is fine to coarse. Platey schist gravels. Well graded. Non plastic, non dilatant. Loose to medium dense.	Moist	ALLUVIAL FAN DEPOSIT
		0.6				
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
		2.2		Dark brown, silty sandy GRAVEL. Gravels generally >150mm in sand and silt matrix. Well graded. Non plastic, non dilatant. Medium dense to dense.	Dry	RIVER GRAVELS
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

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COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope <5°

EASTING:	2189975 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568477 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Dark brown, silty sandy GRAVEL. Gravels generally >150mm in sand and silt matrix. Well graded. Non plastic, non dilatant. Medium dense to dense.	Dry	RIVER GRAVELS
		3.6		Total Depth = 3.5 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 11**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope ≈10°

EASTING:	2189875 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568518 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	374 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Light brown, sandy SILT. Laminated micaeous silts and fine sands. Non plastic, non dilatant. Very stiff to hard. Pocket penetrometer @ 0.5m is 150kPa, 1.0m and 1.5m is >450kPa. Homogeneous.	Dry	LAKE SEDIMENTS
		0.6				
		0.8				
		1.0				
		1.2				
		1.4		Light brown, gravelly SILT. Gravel is fine to coarse and very rounded in a silty matrix. Non plastic. Hard. Horizontally thinly bedded.	Dry	LAKE SEDIMENTS
		1.6				
		1.8				
		2.0				
		2.2		Grey blue, silty sandy GRAVEL. Gravel is fine to medium. Occasional coarse quartz and schist clasts. Non plastic, non dilatant. Medium dense to dense. Bedding layers are sub parallel to ground.	Dry	RIVER GRAVELS
		2.4		Light brown, silty GRAVEL with boulders. Silt is very fine. Gravel is fine to coarse with rounded clasts. Some platey boulders. Well graded. Non plastic. Medium dense. Bedded parallel to slope.	Dry	RIVER GRAVELS
		2.6				
		2.8				
		3.0				
		3.2				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 11**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope ≈10°

EASTING:	2189875 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568518 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	374 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, silty GRAVEL with boulders. Silt is very fine. Gravel is fine to coarse with rounded clasts. Some platey boulders. Well graded. Non plastic. Medium dense. Bedded parallel to slope.	Dry	RIVER GRAVELS
		3.6		Total Depth = 3.6 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 12**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	2189816 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568535 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT. Uniform. Non plastic. Firm to stiff. Homogeneous.	Moist	TOPSOIL
		0.4		Light brown/tan, SILT with minor sand and gravel. Sand is very fine. Gravel is fine. Non plastic. Stiff to very stiff/hard. Pocket penetrometer @0.5m is 200kPa and >1.0m is >450kPa. Homogeneous.	Moist to dry	LAKE SEDIMENTS
		0.6				
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
		2.2		Light brown/tan, SILT and SAND with some gravel. Sand is very fine. Unit becomes sandier with depth. Gravel is fine, platey, and sub-rounded. Non plastic. Hard to dense. Homogeneous.	Dry	LAKE SEDIMENTS
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 12**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	2189816 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568535 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown/tan, SILT and SAND with some gravel. Sand is very fine. Unit becomes sandier with depth. Gravel is fine, platey, and sub-rounded. Non plastic. Hard to dense. Homogeneous.	Dry	LAKE SEDIMENTS
		3.6				
		3.8				
		4.0				
				Total Depth = 4 m		
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 13**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	2189747 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568530 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT with minor gravel. Non plastic. Loose.	Moist	TOPSOIL
		0.2				
		0.3		Dark brown, organic silty GRAVEL. Gravel is medium to coarse with sub-rounded schist clasts. Non plastic. Loose to medium dense. Homogeneous.	Moist	RIVER GRAVELS
		0.4				
		0.5				
		0.6		Light brown, micaeous shiney SILT. No sands or gravel. Laminated. Non plastic. Hard. Pocket penetrometer 300 - >450kPa. Thinly bedded.	Dry to moist	LAKE SEDIMENTS
		0.7				
		0.8				
		0.9				
		1.0				
		1.1				
		1.2				
		1.3				
		1.4				
		1.5				
		1.6				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 3

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 13**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	2189747 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568530 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		1.7		Light brown, micaeous shiney SILT. No sands or gravel. Laminated. Non plastic. Hard. Pocket penetrometer 300 - >450kPa. Thinly bedded.	Dry to moist	LAKE SEDIMENTS
		1.8				
		1.9				
		2.0				
		2.1				
		2.2				
		2.3				
		2.4				
		2.5				
		2.6				
		2.7		Light brown/grey, very sandy GRAVEL. Sand is medium to coarse. Gravel is medium to coarse with large sub-rounded schist clasts. Well graded. Non plastic. Medium dense to dense. Homogeneous.	Dry	RIVER/OUTWASH GRAVEL
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 3

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 13**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	2189747 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568530 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	377 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.3		Light brown/grey, very sandy GRAVEL. Sand is medium to coarse. Gravel is medium to coarse with large sub-rounded schist clasts. Well graded. Non plastic. Medium dense to dense. Homogeneous.	Dry	RIVER/OUTWASH GRAVEL
		3.4				
		3.5				
		3.6				
		3.7				
		3.8				
		3.9				
		4.0				
		4.1		Total Depth = 4 m		
		4.2				
		4.3				
		4.4				
		4.5				
		4.6				
		4.7				
		4.8				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 3 of 3

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 14**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 10°

EASTING:	2189223 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5563079 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	354 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6		Grey silver/brown, SCHIST. Highly weathered. Foliation strike and dip of 239°/80°. Weak. Sheared joint stepped planar at 064° of 58°.	Moist to dry	HIGHLY WEATHERED SCHIST BEDROCK
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
	NO SEEPAGE	2.0				
		2.2				
		2.4		Total Depth = 2.2 m		
		2.6				
		2.8				
		3.0				
		3.2				

COMMENT: Excavation ceased as rock too hard to dig. Large schist boulders observed on the ground surface near test pit.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 15**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 15°

EASTING:	2189306 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5560935 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	356 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6		Brown, silty GRAVEL with minor sand. Gravel is rounded fine to medium with occasional coarse schist to 200mm in a silty matrix. Non plastic. Loose to medium dense. Homogeneous.	Moist	ALLUVIAL FAN DEPOSIT
		0.8				
		1.0				
		1.2		Grey brown, silty sandy GRAVEL. Sand is fine to coarse. Gravel is fine to medium with occasional micaeous, platey, angular to sub-angular schists clasts to 600mm. Non plastic. Medium dense. Homogeneous.	Dry	RIVER GRAVELS
		1.4				
		1.6				
		1.8				
		2.0				
		2.2				
		2.4				
	NO SEEPAGE	2.6		Dark grey, silty sandy GRAVEL. Highly weathered. Fines matrix supporting medium to coarse, angular schist gravels. Well graded. Non plastic. Medium dense to dense. Massive.	Dry	HIGHLY WEATHERED SCHIST BEDROCK
		2.8		Total Depth = 2.8 m		
		3.0				
		3.2				

COMMENT: Excavation ceased as rock too hard to dig.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 16**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 20-25

EASTING:	2189461 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568953 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	359 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Brown, organic SILT with rootlets. Non plastic, non dilatant. Firm. Homegeneous.	Moist	TOPSOIL
		0.2				
		0.3		Brown, organic SILT with rootlets and occasional gravels and sands. Sand is fine to coarse, gravel is fine. Non plastic. Firm to stiff. Homegeneous.	Moist	REMNANT TOPSOIL
		0.4				
		0.5				
		0.6		Grey brown, silty sandy GRAVEL. Sand is micaeous/schistose. Gravel is fine to medium, rounded and platey with occasional large angular schists. Non plastic. Medium dense. Homegeneous.	Dry	RIVER GRAVELS
		0.7				
		0.8				
		0.9				
		1.0				
		1.1				
		1.2				
		1.3				
		1.4				
		1.5				
		1.6				

Log continued on next page

COMMENT: Excavation ceased as rock too hard to dig.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 16**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 20-25°

EASTING:	2189461 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568953 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	359 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7		Grey brown, silty sandy GRAVEL. Sand is micaeous/schistose. Gravel is fine to medium, rounded and platey with occasional large angular schists. Non plastic. Medium dense. Homegeneous.	Dry	RIVER GRAVELS
		1.8				
		1.9				
		2.0				
		2.1				
		2.2				
		2.3				
		2.4				
		2.5				
		2.6		Blue grey, weathered SCHIST. Foliated. Weak. Dry.		WEATHERED SCHIST BEDROCK
		2.7		Total Depth = 2.6 m		
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: Excavation ceased as rock too hard to dig.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 17**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 0°

EASTING:	2189691 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568941 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	352 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT with rootlets. Non plastic. Firm.	Moist	TOPSOIL
		0.2		Dark brown, SILT. Slightly plastic. Firm to stiff. Max pocket penetrometer is 200kPa. Homegeneous.	Moist	REMNANT TOPSOIL
		0.3				
		0.4				
		0.5				
		0.6				
		0.7				
		0.8				
		0.9		Brown, sandy GRAVEL. Dominantly sand and rounded gravels. Sand is fine to coarse. Gravel is fine to medium schist. Gap graded. Non plastic. Medium dense. Horizontally bedded.	Moist	RIVER GRAVELS
		1.0				
		1.1				
		1.2				
		1.3		Black, GRAVEL with minor sand. Gravel is medium to coarse, platey and rounded. Poorly graded. Loose to medium dense. Homegeneous.	Dry	RIVER GRAVELS
		1.4		Brown grey, silty sandy GRAVEL. Large angular schist clasts to 300mm. Weathered schist profile erosion. Non plastic. Medium dense. Homegeneous.	Dry	RIVER GRAVELS
		1.5				
		1.6				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 17**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 0°

EASTING:	2189691 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568941 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	352 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		1.7		Brown grey, silty sandy GRAVEL. Large angular schist clasts to 300mm. Weathered schist profile erosion. Non plastic. Medium dense. Homegeneous.	Dry	RIVER GRAVELS
		1.8				
		1.9				
		2.0				
		2.1		Grey blue, SCHIST. Highly weathered, very decomposed. Foliated. Soft to moderately hard.	Dry	HIGHLY WEATHERED SCHIST BEDROCK
		2.2				
		2.3				
		2.4				
		2.5				
		2.6				
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
	NO SEEPAGE	3.2				

Total Depth = 3.2 m

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 18**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	2189756 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5563910 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	353 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT. Slightly plastic to non plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Brown, SILT with sand, becoming gravel with depth. Sand is fine to coarse in a silty matrix soil. Slightly plastic. Firm to stiff. Pocket penetrometer @ 0.4m is 100kPa and 0.6m is 200kPa. Homogeneous.	Moist	REMNANT TOPSOIL
		0.6				
		0.8				
		1.0		Tan/light brown, silty GRAVEL with sandy schist and minor clay. Sand is fine to coarse. Gravel is fine to medium, rounded and platey. Non plastic. Medium dense. Homogeneous.	Dry	RIVER GRAVELS
		1.2				
		1.4				
		1.6		Light brown, silty sandy GRAVEL. Sand is fine to medium. Gravel is platey, rounded schist. Non plastic. Medium dense to dense. Horizontally fine to coarse layers 200mm deep.	Dry	RIVER GRAVELS
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT: Hard material (Schist?) at maximum reach.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 18**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction:

EASTING:	2189756 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5563910 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	353 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, silty sandy GRAVEL. Sand is fine to medium. Gravel is platey, rounded schist. Non plastic. Medium dense to dense. Horizontally fine to coarse layers 200mm deep.	Dry	RIVER GRAVELS
				Total Depth = 3.4 m		SCHIST BEDROCK AT BASE OF EXCAVATION
		3.6				
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT: Hard material (Schist) at maximum reach.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 19**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	2189914 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568893 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	351 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Black/dark brown, organic SILT. Non plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.2		Dark brown, gravelly SILT. Non plastic. Stiff. Homogeneous.	Moist	REMNANT TOPSOIL
		0.3				
		0.4				
		0.5				
		0.6		Dark brown, silty GRAVEL. Small gravels are angular to sub-rounded. Non plastic. Medium dense. Homogeneous.	Moist	RIVER GRAVELS
		0.7				
		0.8				
		0.9				
		1.0				
		1.1				
		1.2				
		1.3		Grey/light brown, GRAVEL with minor sands and silts. Sand is fine. Gravel is fine to medium and very rounded - beach or delta deposit. Poorly graded, non plastic. Loose. Homogeneous.	Dry	RIVER GRAVELS
		1.4				
		1.5				
		1.6		Tan, sandy SILT. Non plastic. Very stiff to hard. Pocket penetrometer @1.6m is 300kPa. Bedded horizontally 1-5mm.	Dry	RIVER GRAVELS

Log continued on next page

COMMENT: Too hard to excavate beyond 2.5m. Greenschist exposed at bottom of hole - Foliation is 146° at 72°, moderately strong and dry.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 19**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 5°

EASTING:	2189914 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568893 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	351 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7		Tan, sandy SILT. Non plastic. Very stiff to hard. Pocket penetrometer @1.6m is 300kPa. Bedded horizontally 1-5mm.	Dry	RIVER GRAVELS
		1.8				
		1.9				
		2.0				
		2.1		Tan, SAND with silt. Sand is fine to medium, quartz and mica's. Non plastic. Medium dense. Bedded horizontally 5-10mm.	Dry	RIVER GRAVELS
		2.2				
		2.3				
		2.4				
		2.5				
		2.6		Total Depth = 2.5 m		SCHIST BEDROCK AT BASE OF EXCAVATION
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: Too hard to excavate beyond 2.5m. Greenschist exposed at bottom of hole - Foliation is 146° at 72°, moderately strong and dry.	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 20**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	2190074 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5568821 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	363 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Organic SILT with minor gravel and rootlets. Gravel is fine to coarse. Non plastic. Very stiff. Homogeneous.	Moist	TOPSOIL
		0.4				
		0.6		Sandy GRAVEL with minor silt. Gravel is medium to coarse, platey rounded schist. Non plastic. Medium dense to dense. Homogeneous.	Moist	RIVER GRAVELS
		0.8				
		1.0				
		1.2				
		1.4		Sandy GRAVEL. Sand is fine, gravel is rounded fine to medium. Loose to medium dense. Homogeneous.	Moist	RIVER GRAVELS
		1.6				
		1.8				
		2.0		SAND, fine to coarse and rounded. Medium dense. Laminated horizontal beds of 5-10mm.	Dry	RIVER GRAVELS
	NO SEEPAGE	2.2				
		2.4				
		2.6		Total Depth = 2.4 m		SCHIST BEDROCK AT BASE OF EXCAVATION
		2.8				
		3.0				
		3.2				

COMMENT: Test pit is on a flat area, upslope of exposed bedrock. Unable to excavate beyond 2.4m as schist bedrock encountered	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 21**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 10°

EASTING:	2190233 mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	5563790 mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	352 m	DIMENSIONS:	HOLE STARTED: 11-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 11-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Organic SILT with minor gravel. Gravel is angular to sub-rounded. Non plastic. Stiff. Homogeneous.	moist	TOPSOIL
		0.4		GRAVEL with some silt, sand and boulders. Greenschist boulders up to 1.0m diameter. Non plastic. Loose to medium dense. Homogeneous.	Moist	RIVER GRAVELS
		0.8				
		1.2		SCHIST. Highly weathered. Schistose. Foliated 128° and 78°. Weak.	Dry	HIGHLY WEATHERED SCHIST BEDROCK
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
		3.6				
	NO SEEPAGE	4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 22**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	mE	EQUIPMENT: 10T excavator		OPERATOR: Jason	
NORTHING:	mN	INFOMAP NO.		COMPANY: Jones Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 12-Oct-07	
METHOD:		EXCAV. DATUM: Ground level		HOLE FINISHED: 12-Oct-07	

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		Dark brown, organic SILT with rootlets. Slightly plastic to non plastic. Firm. Massive.	Moist	TOPSOIL
		0.4		Brown, SILT with a large tree root. Slightly plastic. Firm. Massive.	Moist	COLLUVIUM
		0.6				
		0.8				
		1.0				
		1.2				
		1.4		Cream, SILT with minor sand. Very light. Possibly bioturbated fossils. Non plastic. Stiff to very stiff. Pocket penetrometer is >300kPa. Massive. Dipping 10° towards 180°.	Moist to dry	COLLUVIUM
		1.6		White grey, GRAVEL and sand. Gravel is medium to coarse, platey, rounded schist and quartz. Sand is coarse. Occasional 100mm highly weathered schist. Loose to medium dense. Massive. Dipping 10° towards 180°.	Dry	RIVER GRAVELS
		1.8		Cream, SILT and SAND with minor gravel. Gravel is rounded. Some burrows - possibly fossils. Non plastic. Very stiff. Massive. Dipping 10° towards 180°.	Dry	RIVER GRAVELS
		2.0		Light brown, silty SAND with minor gravel. Cohesive silt with white fossils. Gravel is rounded. Non plastic. Medium dense, becoming more dense with depth. Massive. Dipping 10° towards 180°.	Very dry	RIVER GRAVELS
		2.2				
		2.4				
		2.6				
		2.8				
		3.0				
		3.2				

Log continued on next page

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

Tonkin & Taylor

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 22**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan	Inclination:	Vertical	Direction: Ground slope 10°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	3.4		Light brown, silty SAND with minor gravel. Cohesive silt with white fossils. Gravel is rounded. Non plastic. Medium dense, becoming more dense with depth. Massive. Dipping 10° towards 180°.	Very dry	RIVER GRAVELS
		3.6		Total Depth = 3.6 m		
		3.8				
		4.0				
		4.2				
		4.4				
		4.6				
		4.8				
		5.0				
		5.2				
		5.4				
		5.6				
		5.8				
		6.0				
		6.2				
		6.4				

COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

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TONKIN & TAYLOR LTD

EXCAVATION NUMBER: **TP 23**

PROJECT: Gibbston Valley Station			Job Number: 880063
LOCATION: See Site Plan		Inclination: Vertical	Direction: Ground slope 25°

EASTING:	mE	EQUIPMENT: 10T excavator	OPERATOR: Jason
NORTHING:	mN	INFOMAP NO.	COMPANY: Jones Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 12-Oct-07
METHOD:		EXCAV. DATUM: Ground level	HOLE FINISHED: 12-Oct-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.0		Dark brown, organic SILT with rootlets. Slightly plastic. Firm. Homogeneous.	Moist	TOPSOIL
		0.4		Brown, silty GRAVEL. Non plastic. Loose to medium dense. Homogeneous.	Moist	COLLUVIUM
		0.8		Light brown, SILT with minor gravel and sand. Sand is fine and micaeous. Non plastic. Stiff to very stiff. Homogeneous.	Moist	ALLUVIAL FAN DEPOSIT
		1.2				
		1.6		Brown, silty GRAVEL with sand. Gravel is angular to sub-rounded schist (max size 150mm) in a fine silt matrix. Sand content increases with depth. Well graded. Non plastic. Medium dense to dense. Horizontally bedded.	Moist to dry	RIVER GRAVELS
		2.0				
		2.4				
		2.8				
		3.2				
		3.6				
	NO SEEPAGE	4.0				
		4.4		Total Depth = 4 m		
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

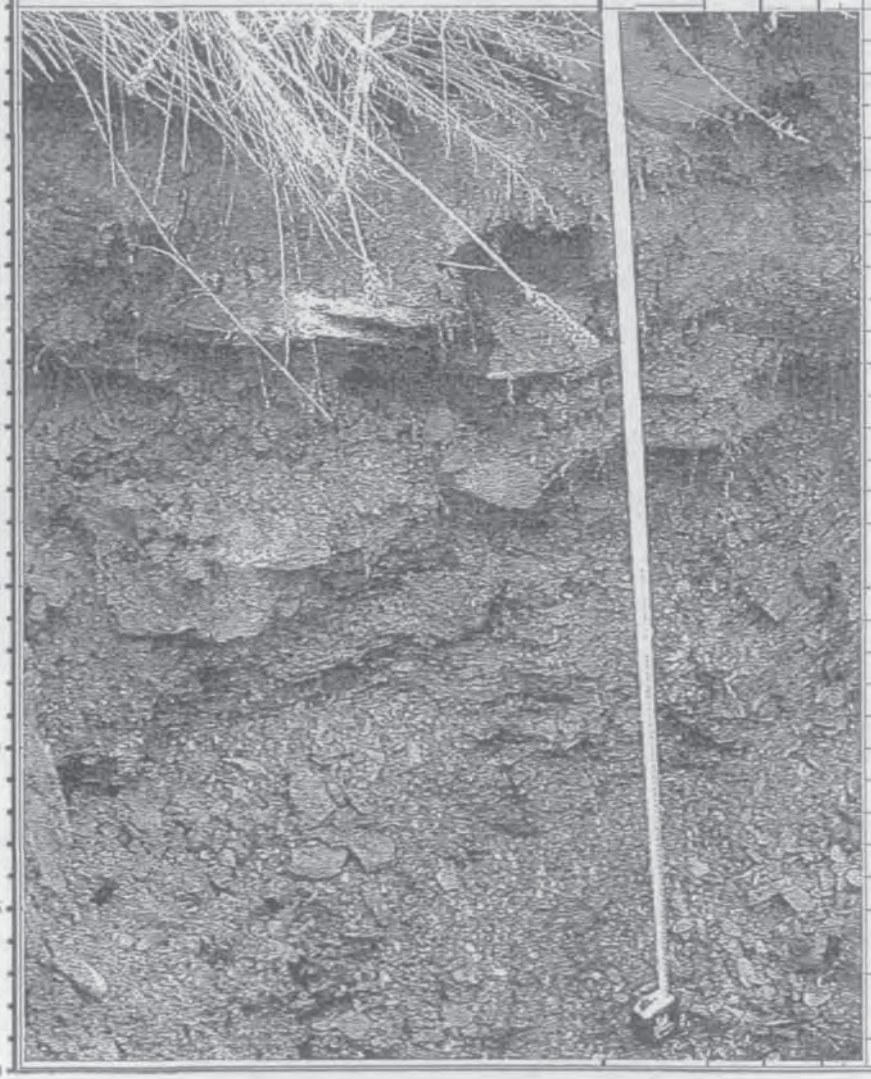
COMMENT:	Logged By: SCWW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	1
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.60

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2190242 E, 5568799 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0–50–100)	SCALA PENETROMETER (mm/blow) (0–34–50–100–150)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
brownish grey silt loam, massive structure, firm soil strength well graded and tightly packed with fine, medium and coarse schist gravels and cobbles	SM					
Grey crumbly folded schist, with 50% fine gravel, 20 % medium gravel and 10 % coarse gravel	GW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

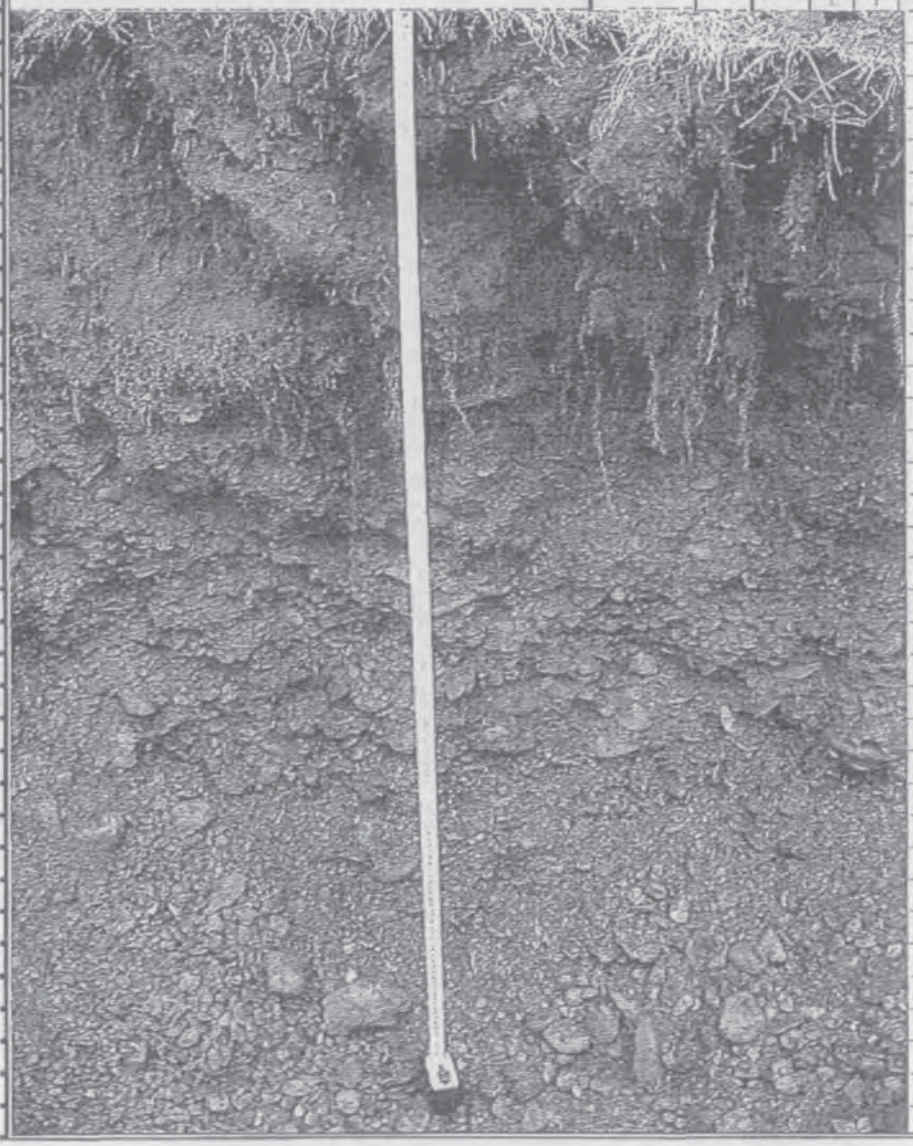
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	2
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2190166 E, 5566702 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:

Notes:

Depth	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 60 100 150
0.0	brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
0.5	brownish grey gravels, massive structure, well graded and tightly packed with fine, medium and coarse schist gravels and cobbles	GW					
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

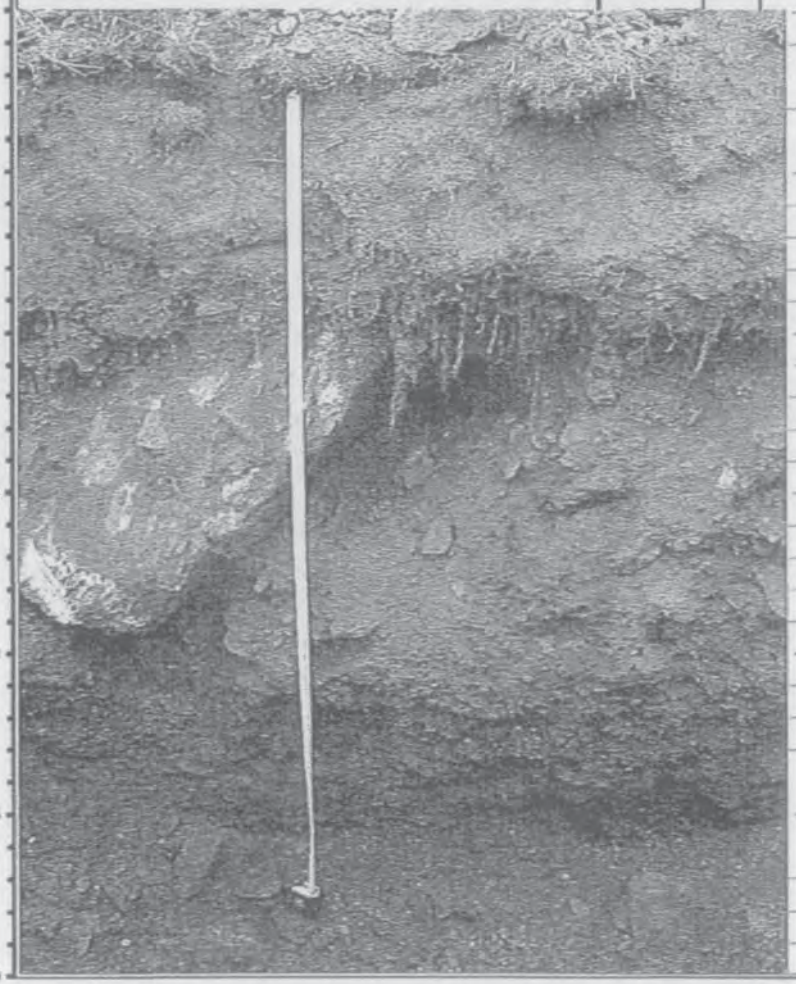


TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	3
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.90

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2190074 E, 5568817 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (50 100)	SCALA PENETROMETER (mm/blow) (0 34 50 100 150)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
Grey silty sand, massive structure,soft soil strength,well graded and loosely packed with fine, medium and coarse schist gravel and cobbles and boulders	SM					
Grey Gravel, massive structure, soft soil strength, well graded loosely packed with fine, medium and coarse schist gravels	GW					



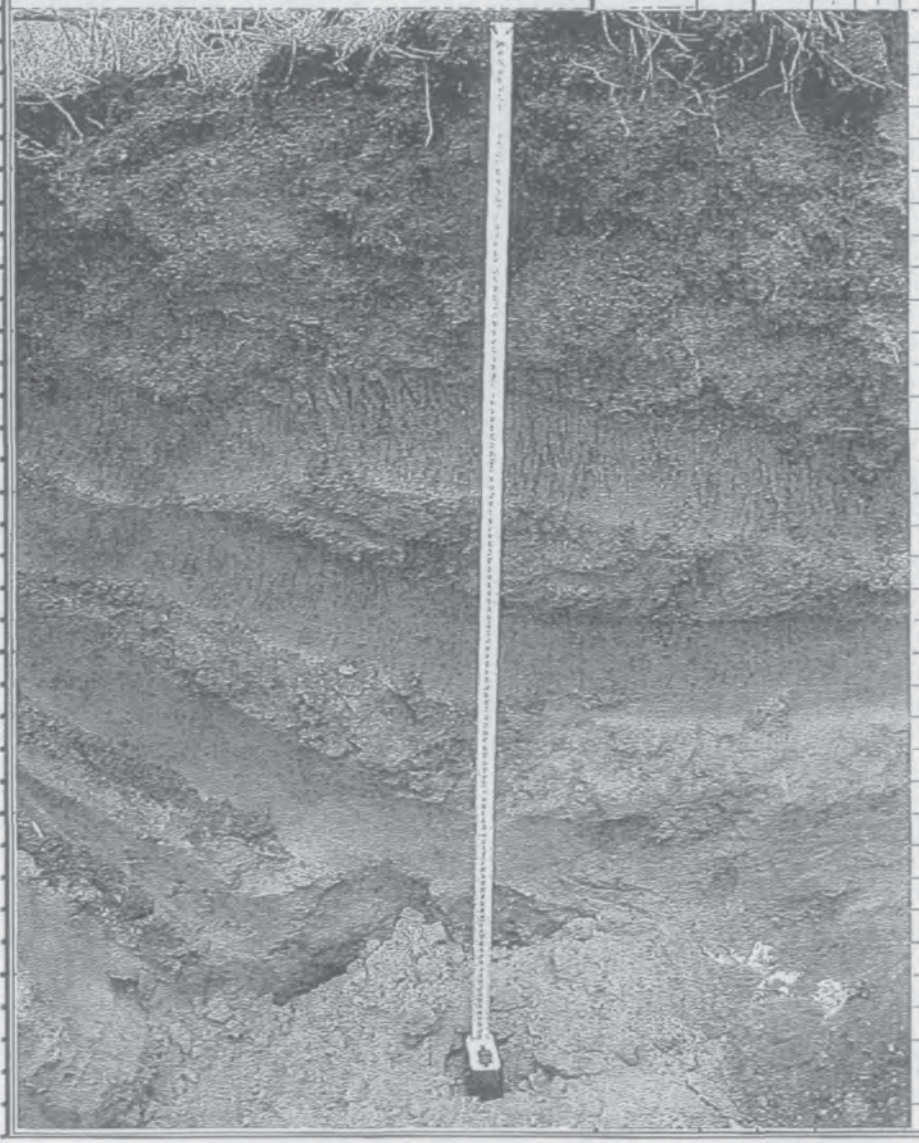
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	4
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189809 E, 5568959 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey sandy silty loam, massive structure, firm soil strength,well graded, tightly packed	SW					
Schist - Bedrock	RX					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

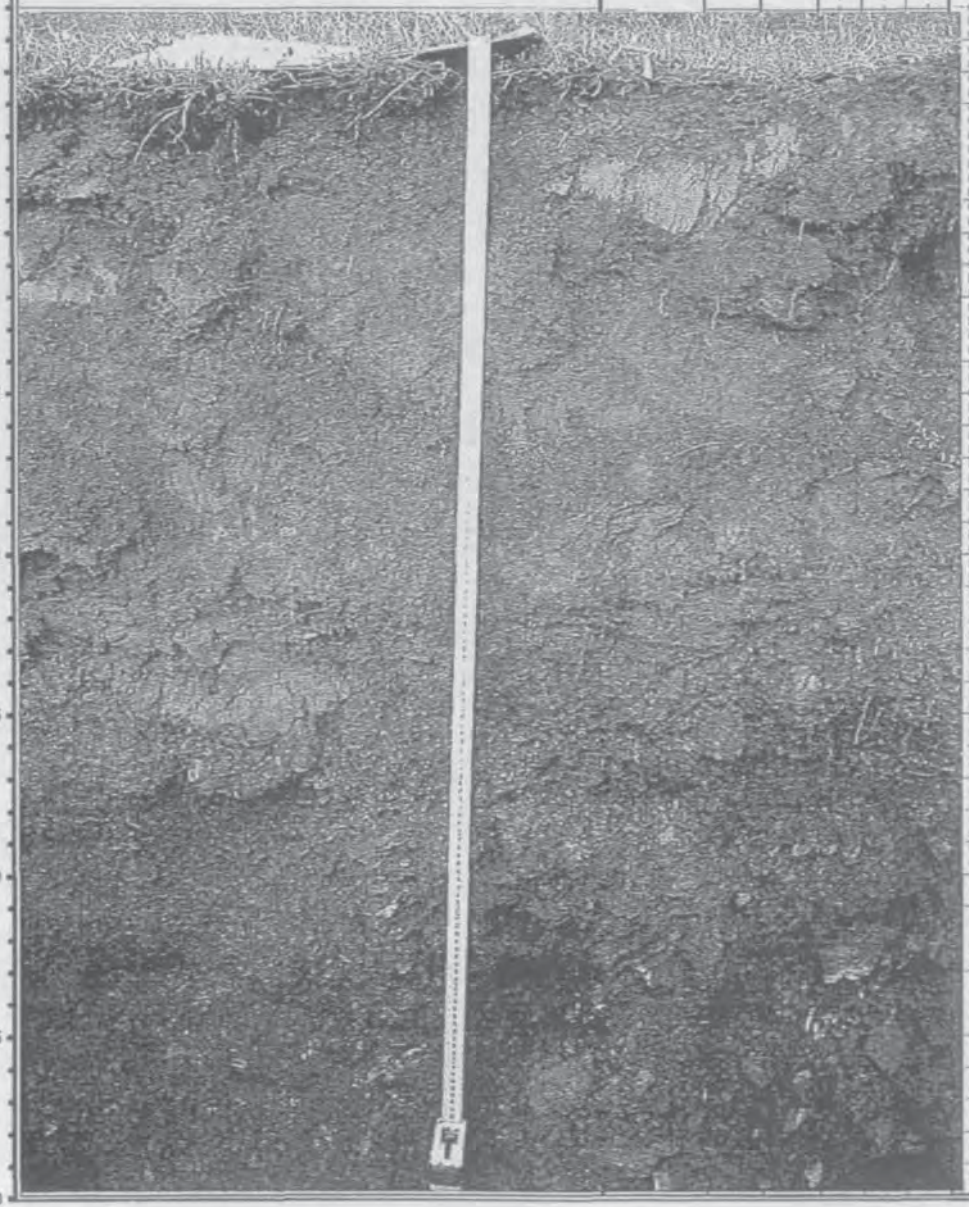
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	5
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.20

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189430 E, 5568985 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L:

Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 20% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
greyish brown silt loam, massive structure, firm soil strength tightly packed, well graded	ML					
Grey sandy gravel, massive structure,soft soil strength,well graded and loosely packed with fine, medium and coarse schist gravel	SG					
Schist - Bedrock	RX					

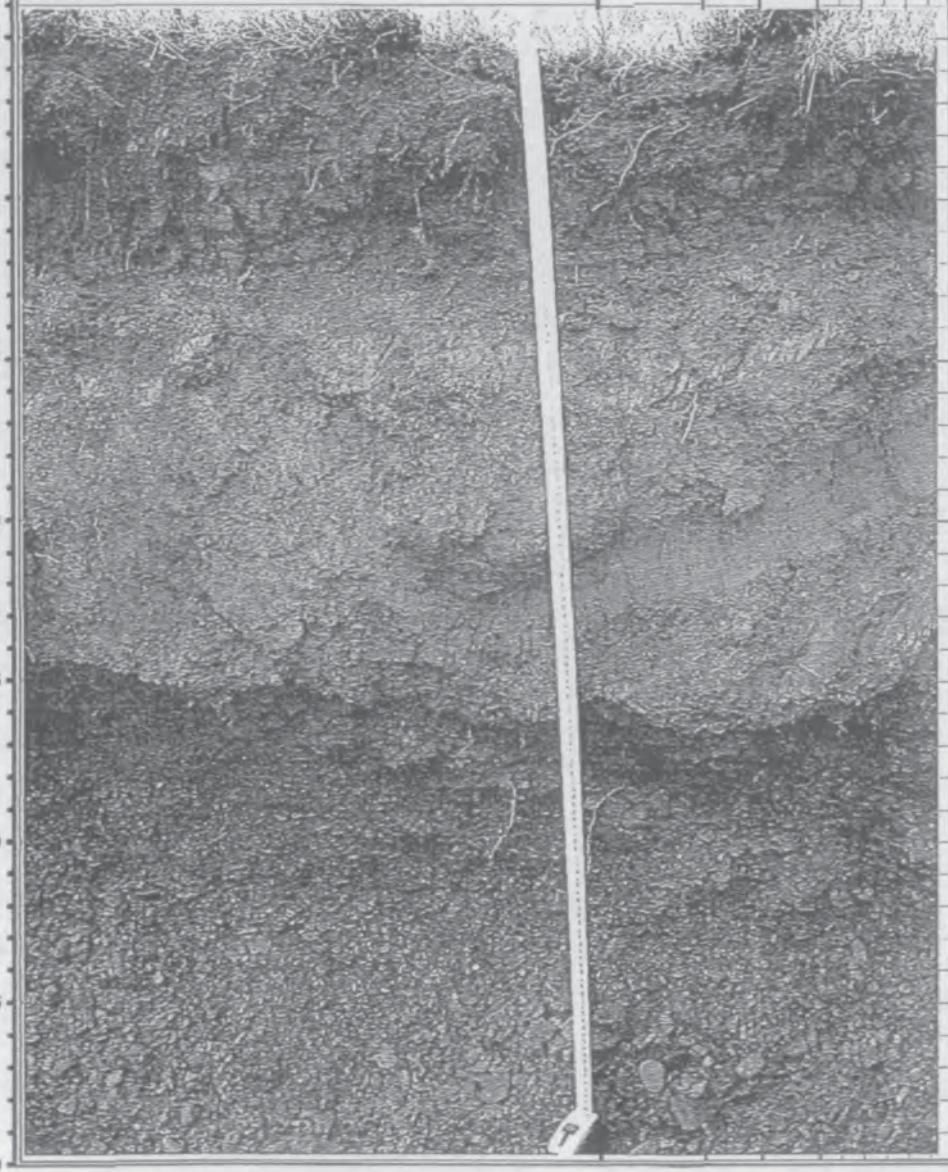


0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

				Hole No:	6
				Job No:	303540
				Logged by:	HW
Project:	Gibbston Valley			Date drilled:	10/10/2007
Client:	Gibbston Valley Station			Checked by:	MR
Hole location:	2189562 E, 5569038 N			Date checked:	
Driller:	Contractor: Jones Contracting	Equipment: 8 tonne Digger	R.L:	Max depth:	1.30
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0–50–100)	SCALA PENETROMETER (mm/blow) (0–34–50–100–150)
brown silty sand , moist soil with 20% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
yellowish brown silt loam, massive structure, firm soil strength tightly packed, well graded	ML					
Grey gravel, massive structure, firm soil strength, well graded and tightly packed with fine, medium and coarse schist gravel	GW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

				Hole No:	7
				Job No:	303540
				Logged by:	HW
Project:	Gibbston Valley			Date drilled:	10/10/2007
Client:	Gibbston Valley Station			Checked by:	MR
Hole location:	2189356 E, 5569254 N			Date checked:	
Driller:	Contractor: Jones Contracting	Equipment:	8 tonne Digger	R.L.:	Max depth: 0.90
Notes:					

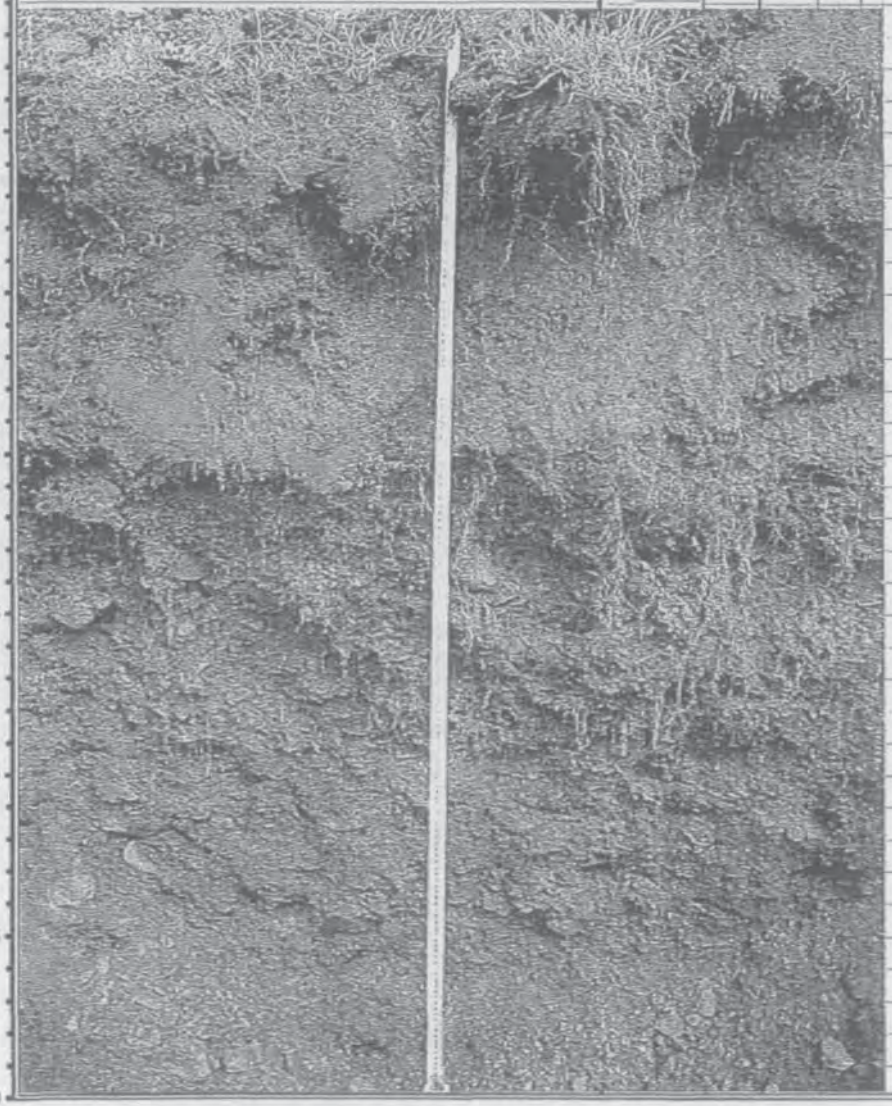
STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
Greyish brown silt loam, massive structure, firm soil strength, well graded and tightly packed	ML					
Schist - Bedrock	RX					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

	Project:	Gibbston Valley		Hole No:	8
	Client:	Gibbston Valley Station		Job No:	303540
	Hole location:	2189150 E, 5569193 N		Logged by:	HW
Driller:	Contractor:	Jones Contracting	Equipment: 8 tonne Digger R.L.:	Date drilled:	10/10/2007
Notes:				Checked by:	MR
				Date checked:	
				Max depth:	1.50

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
Greyish brown sand, massive structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SW					



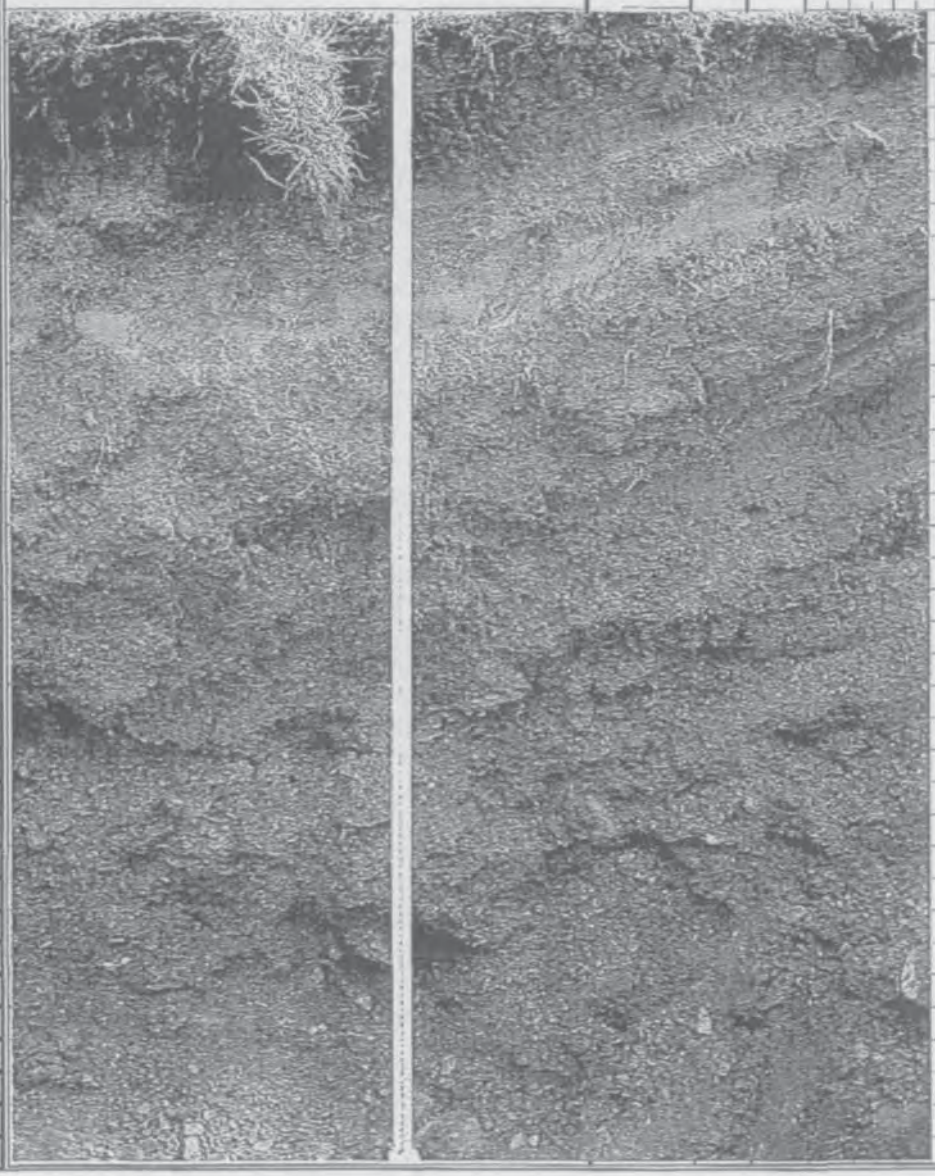
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	9
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.30

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189155 E, 5569407 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (50 100)	SCALA PENETROMETER (mm/blow) (0 34 50 100 150)
0.0 brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
0.5 Greyish sandy gravel, massive structure, firm soil strength, well graded and tightly packed with fine, medium and coarse schist gravel	SG					
1.0						
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						



TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	10
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2188965 E, 5569301 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

Depth	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
0.0	brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
0.5	Grey sandy gravel, with 25% iron staining, massive structure, firm soil strength, well graded, tightly packed and fine, medium and coarse gravel	SG					
1.0	greyish brown silt loam, massive structure, firm soil strength well graded and tightly packed with medium and coarse schist gravel	ML					
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	11
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189039 E, 5569439 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

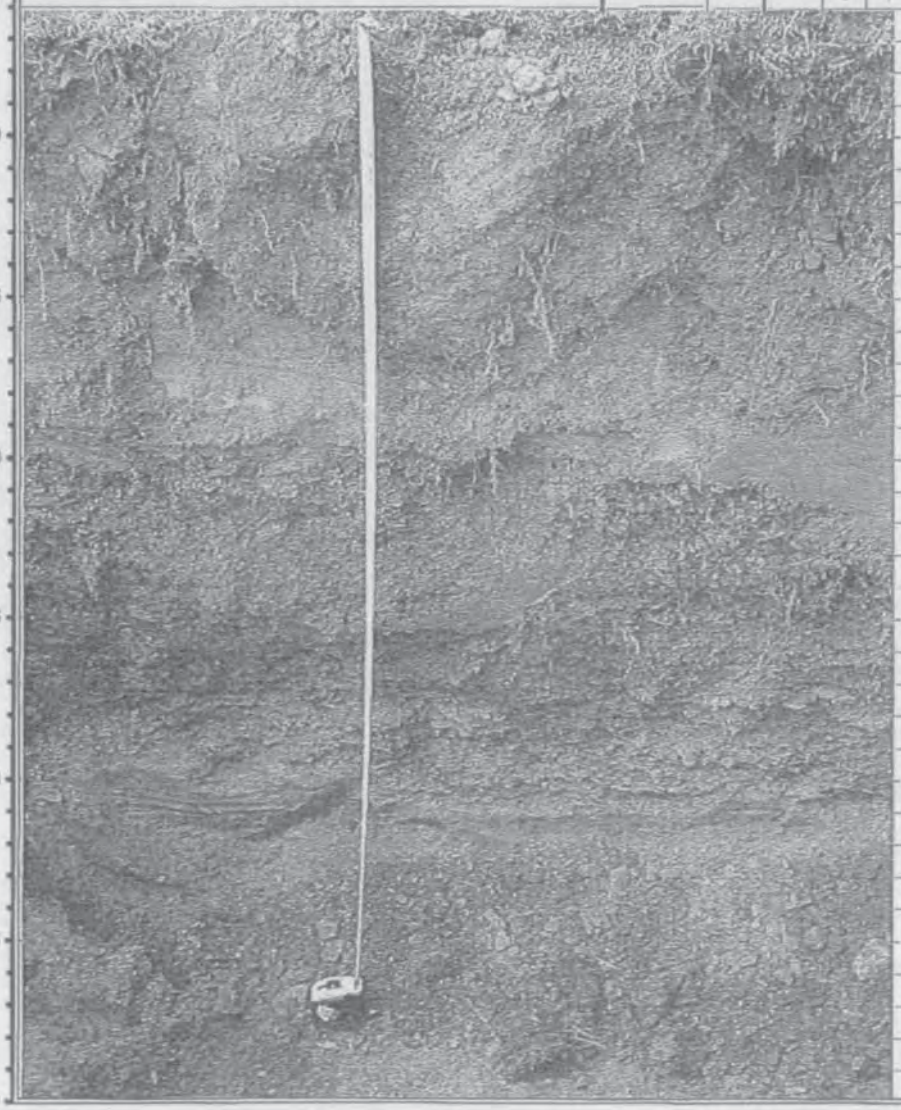
Depth	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0 50 100)	SCALA PENETROMETER (mm/blow) (0 34 50 100 150)	Depth
0.0	brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML	X					0.0
0.5	Grey silt loam, massive structure, firm soil strength, well graded, tightly packed	ML	X					0.5
1.0	greyish brown silt loam, massive structure, firm soil strength well graded and tightly packed with medium and coarse schist gravel and cobbles	ML	X					1.0
1.5								1.5
2.0								2.0
2.5								2.5
3.0								3.0
3.5								3.5
4.0								4.0
4.5								4.5
5.0								5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	12
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project: Gibbston Valley
Client: Gibbston Valley Station
Hole location: 2188784 E, 5569423 N
Driller:
Contractor: Jones Contracting | Equipment: 8 tonne Digger | R.L.:
Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey sandy loam, massive structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SW					
grey sandy loam, massive structure, firm soil strength, well graded, tightly packed	SW					

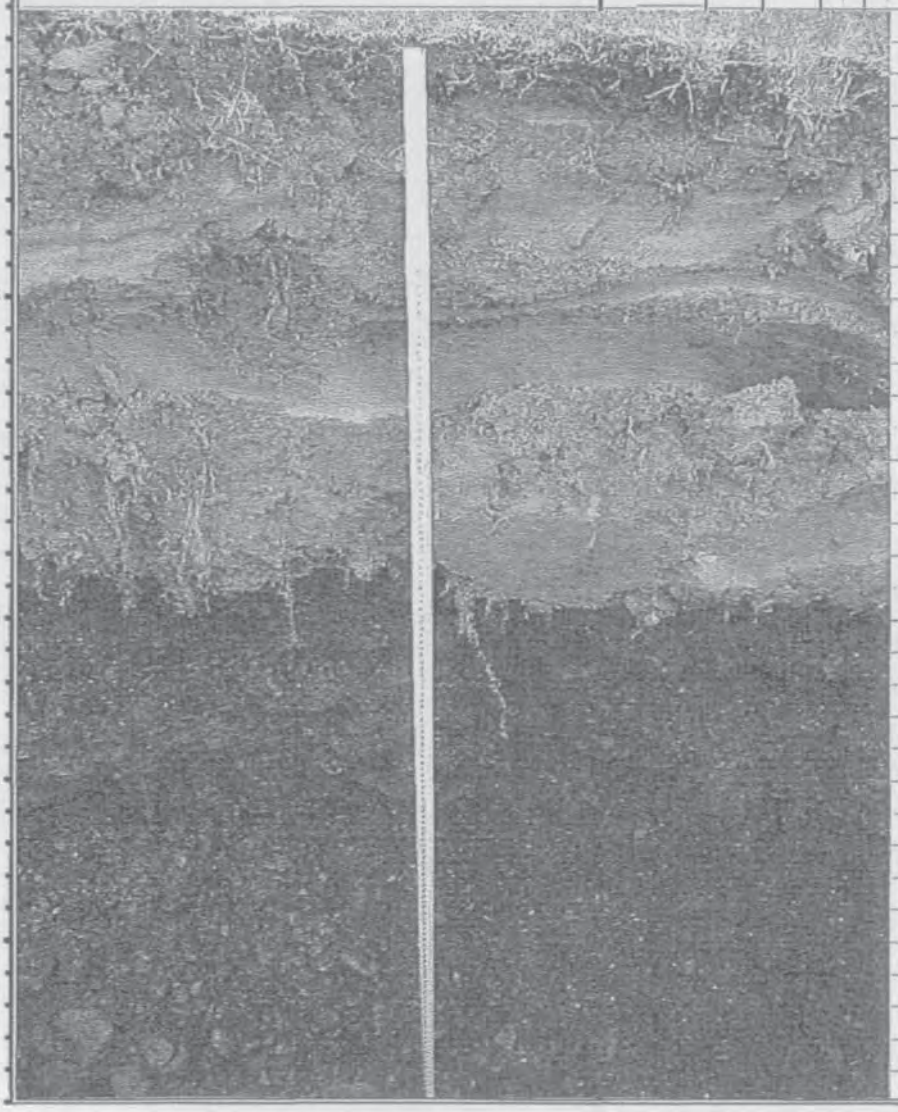


TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	13
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2188673 E, 6569447 N				
Driller:		Contractor:	Jones Contracting	Equipment:	8 tonne Digger
Notes:					

Depth	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 34 50 100 150
0.0	brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
0.5							
1.0	grey sandy gravel, massive structure, firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SG					
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							



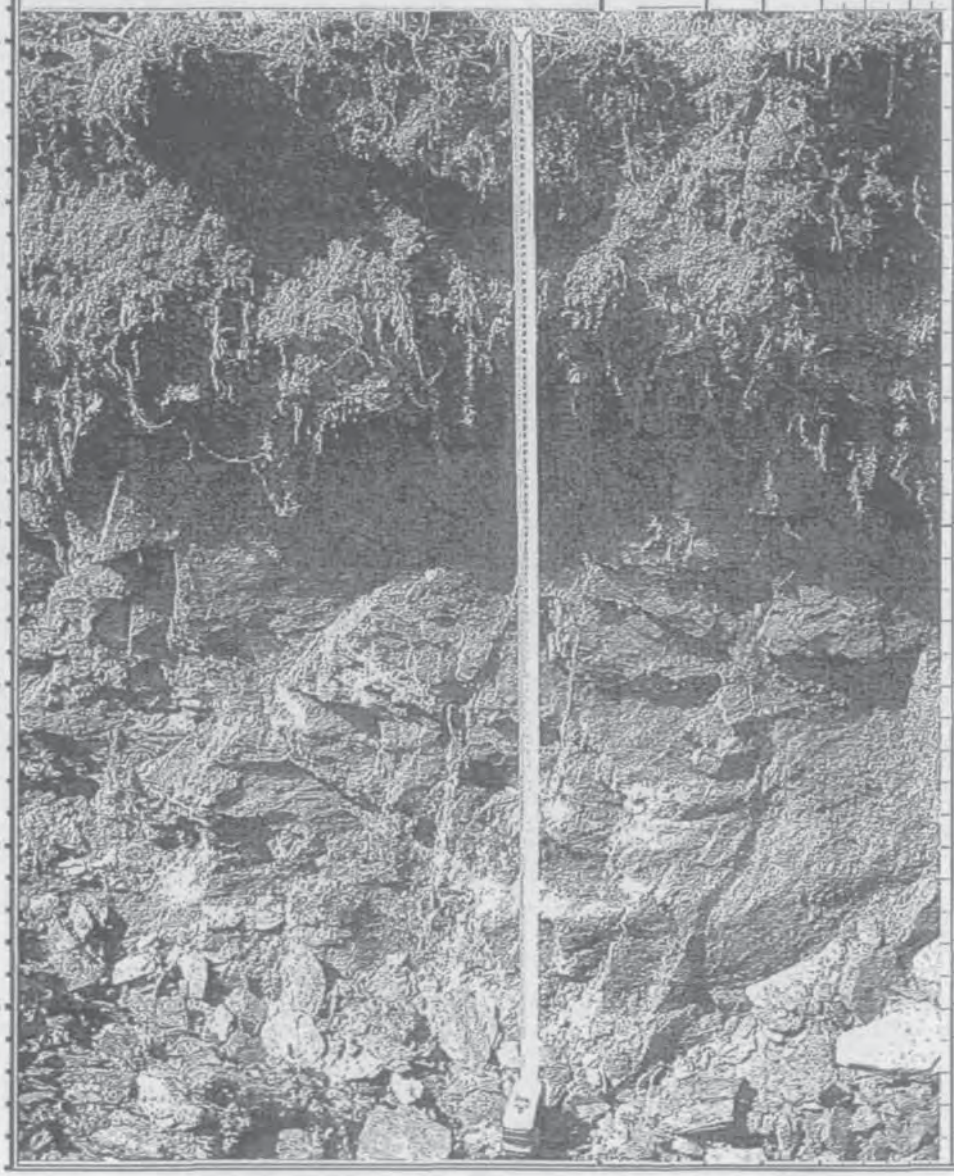
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	14
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.30

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2188403 E, 5569526 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:

Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
Schist bedrock, vertical foliations	RX					



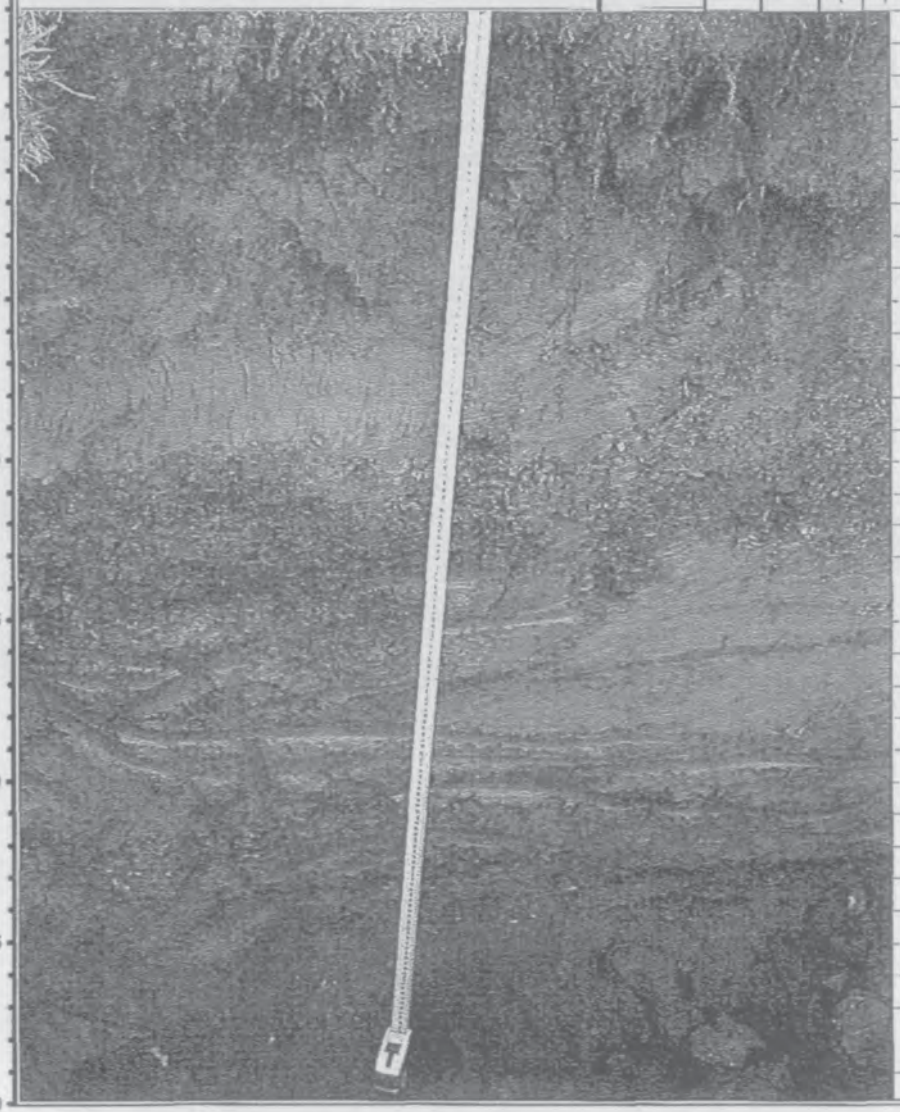
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	15
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project: Gibbston Valley
Client: Gibbston Valley Station
Hole location: 2188282 E, 5569456 N
Driller:
Contractor: Jones Contracting
Equipment: 8 tonne Digger
R.L.:
Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
0.0 – 0.5: brown silt loam , moist soil with 15% roots, massive structure, firm soil strength, well graded and tightly packed	ML					
0.5 – 1.0: greyish brown silt loam, massive structure, firm soil strength, well graded, fine, medium schist gravels and tightly packed	ML					
1.0 – 1.5: grey silt loam, massive structure, firm soil structure, tightly packed and well graded	ML					
1.5 – 5.0: grey silt loam, massive structure, firm soil structure, tightly packed fine, medium schist gravels	ML					

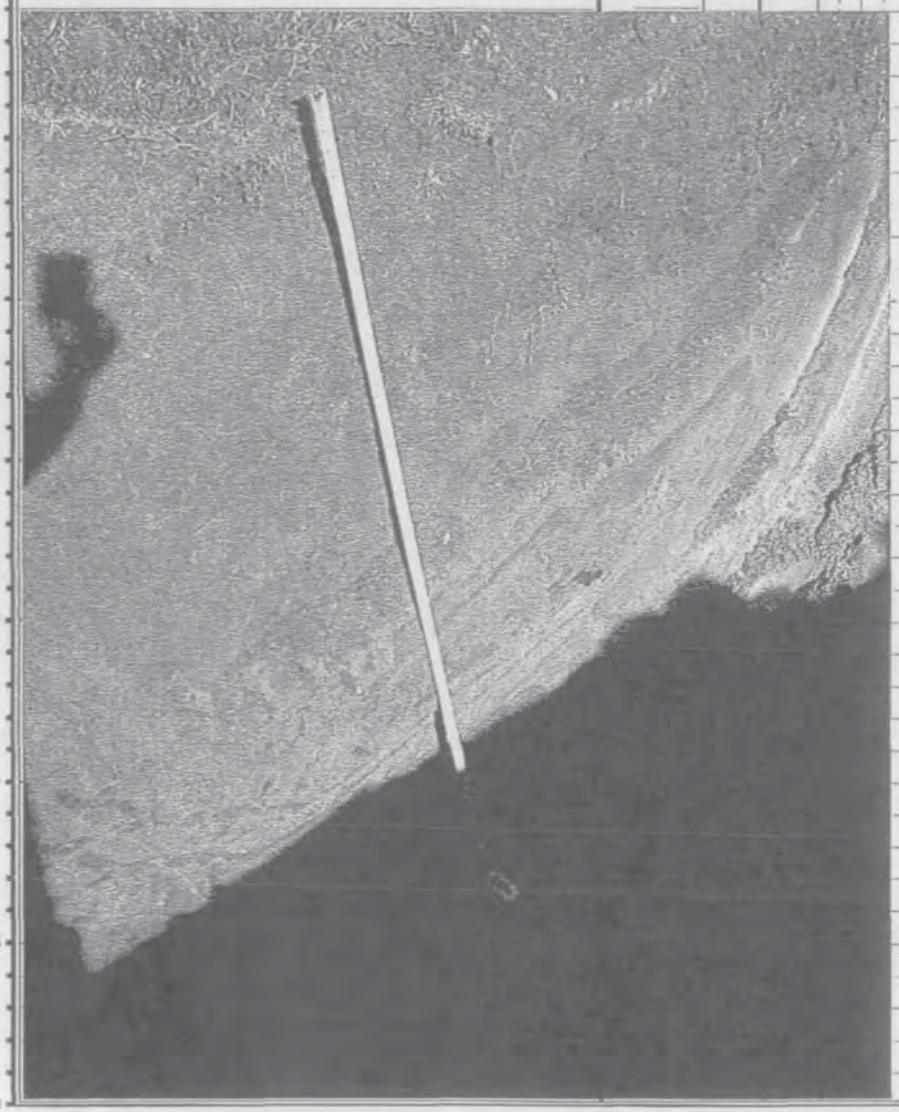


TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	16
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2168161 E, 5569566 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0 – 50 – 150)	SCALA PENETROMETER (mm/blow) (0 – 34 – 50 – 100 – 150)
brown silt loam , moist soil with 15% roots, massive structure, firm soil strength, well graded and tightly packed	ML					
greyish brown silt loam, massive structure, firm soil strength, well graded and tightly packed	ML					



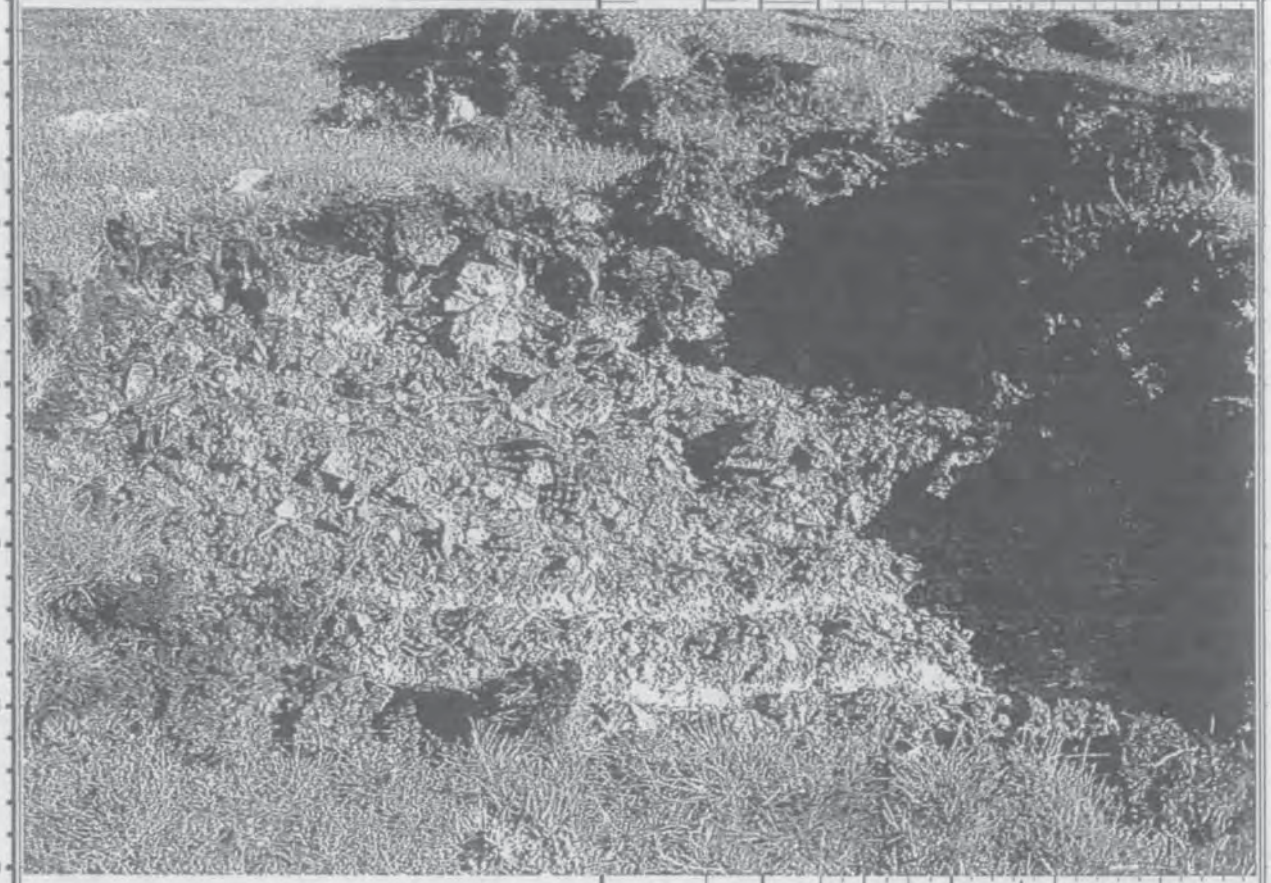
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	17
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	0.20

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2188060 E, 5569695 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silt loam , moist soil with 15% roots, massive structure, well	ML					
Schist Bedrock	RX					



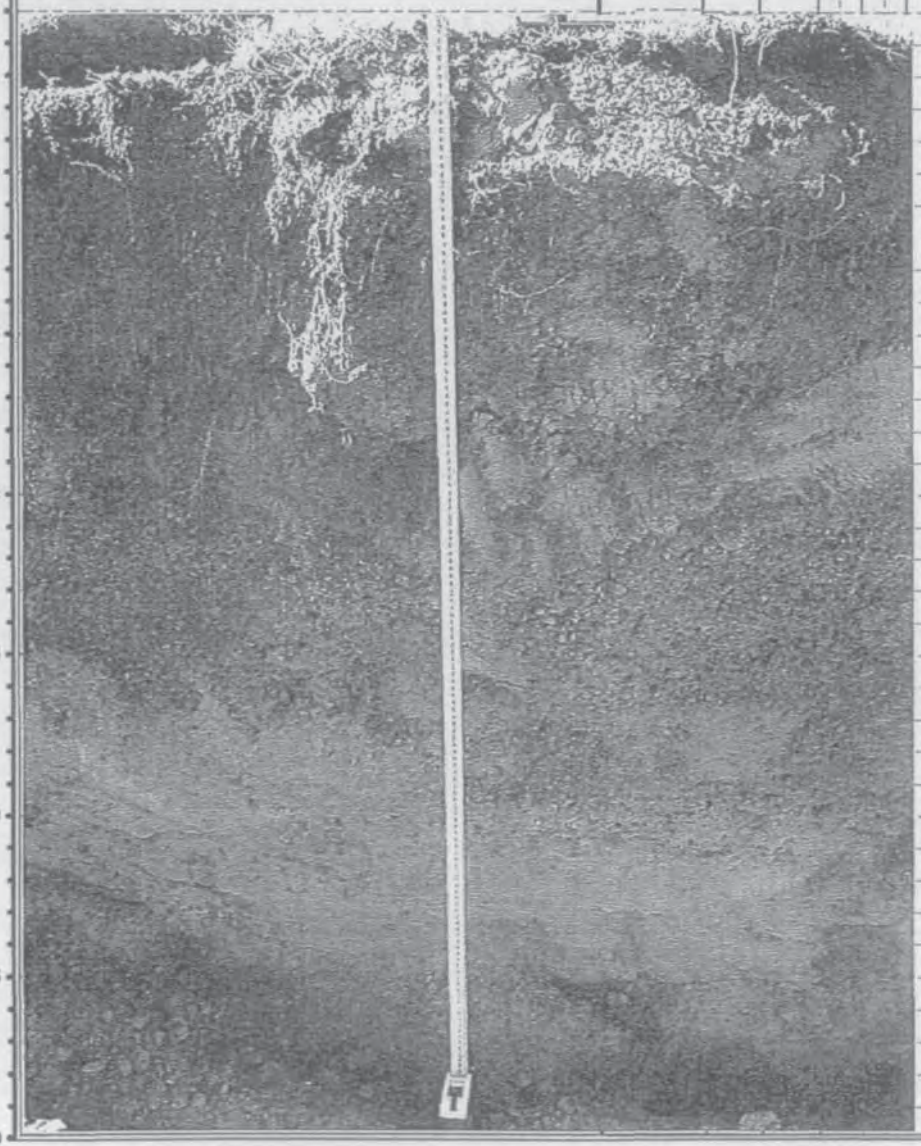
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	18
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2187988 E, 5589581 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
0.0 – 0.5: brown silt loam , moist soil with 20% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
0.5 – 1.0: greyish brown silt loam, massive structure, well graded, firm soil strength and tightly packed	ML					
1.0 – 1.5: grey sandy loam, massive structure, soft soil strength, well graded and tightly packed	SW					



TEST PIT LOG
GLASSON POTTS FOWLER LTD

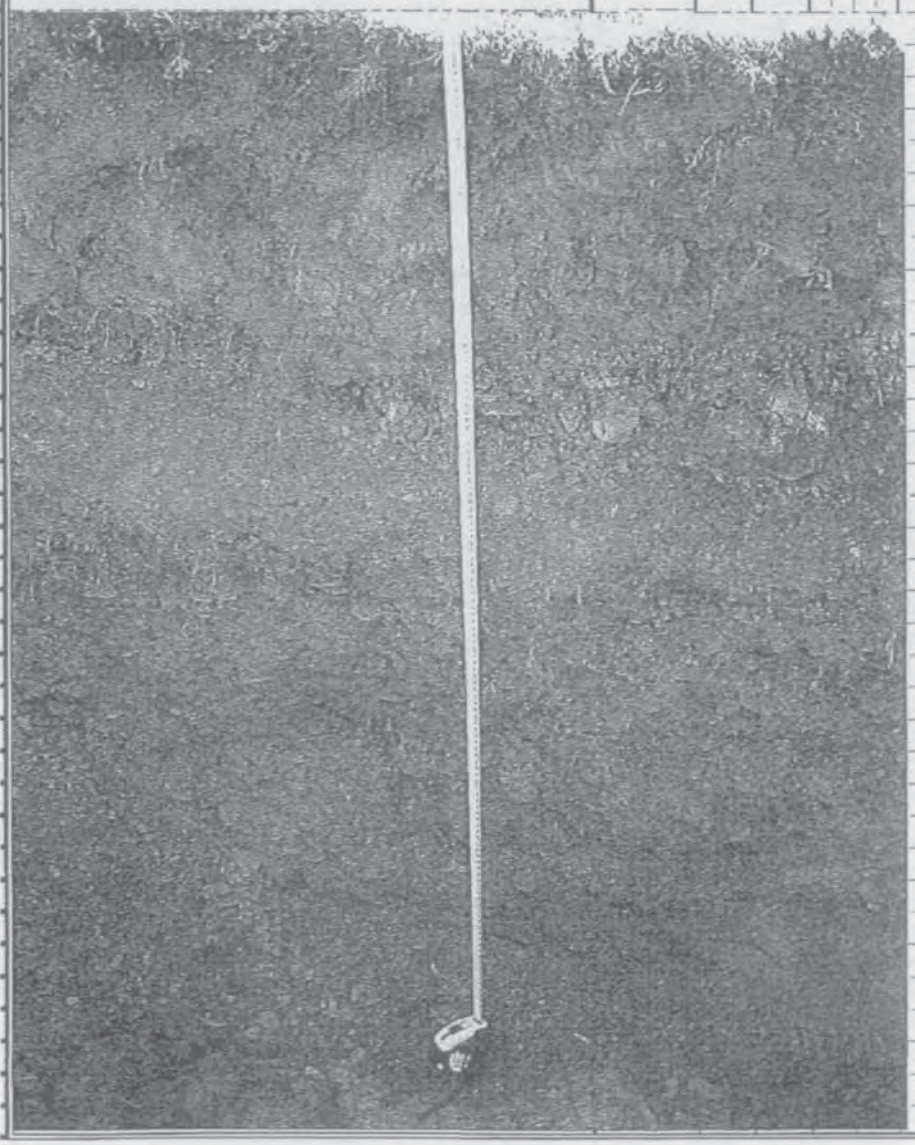
Hole No:	19
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2188066 E, 5569436 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

Depth	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples
0.0	brown silt loam , moist soil with 20% roots, massive structure, well graded, firm soil strength and tightly packed	ML			
0.5	greyish brown silt loam, massive structure, well graded, firm soil strength and tightly packed with fine and medium schist gravels	ML			
1.0	grey sandy gravel, massive structure, soft soil strength, well graded and loosely packed with fine, medium and coarse schist gravels	SG			
1.5					
2.0					
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					

S.P.T N uncorrected (0, 50, 100)

SCALA PENETROMETER (mm/blow) (0, 34, 50, 100, 150)

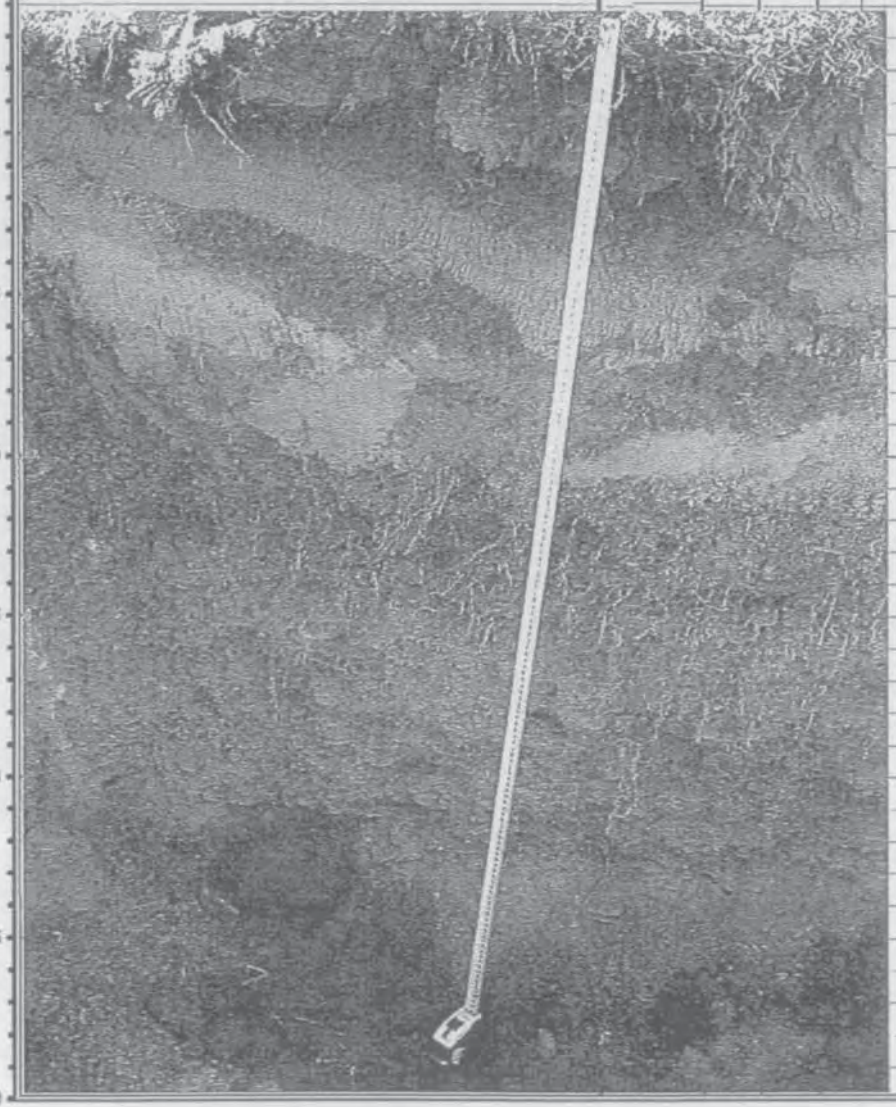


TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	20
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2187690 E, 5559448 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	SM					
grey sandy gravel, massive structure, soft soil strength, well graded and firmly packed with fine, medium and coarse schist gravels	SW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

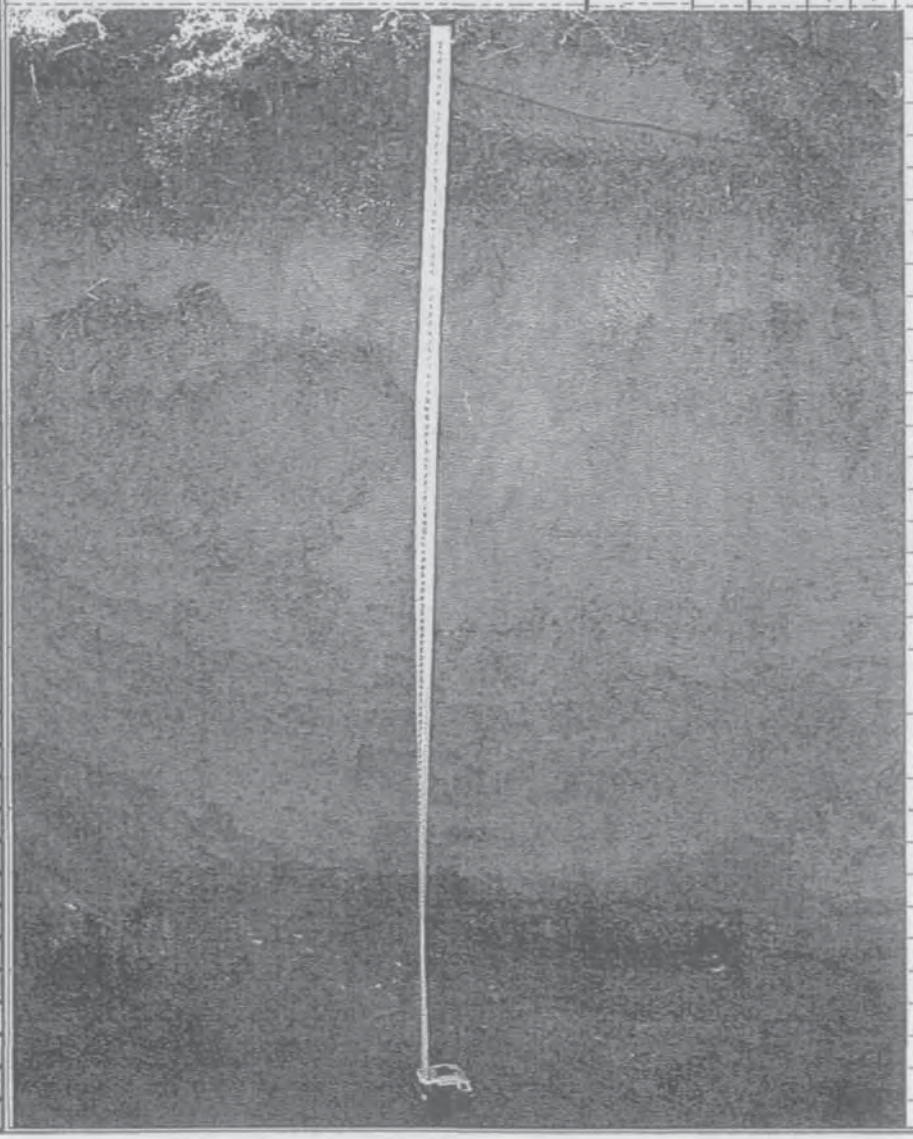
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	21
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2187661 E, 5569503 N				
Driller:		Contractor:	Jones Contracting	Equipment:	8 tonne Digger
Notes:					

R.L.:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0–50–100)	SCALA PENETROMETER (mm/blow) (0–34–65–100–150)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey silt loam , massive structure, firm soil strength, well graded tightly packed	ML					
greyish brown silty sand, massive structure, firm soil strength, well graded, firmly packed with fine, medium and coarse schist gravels	SM					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

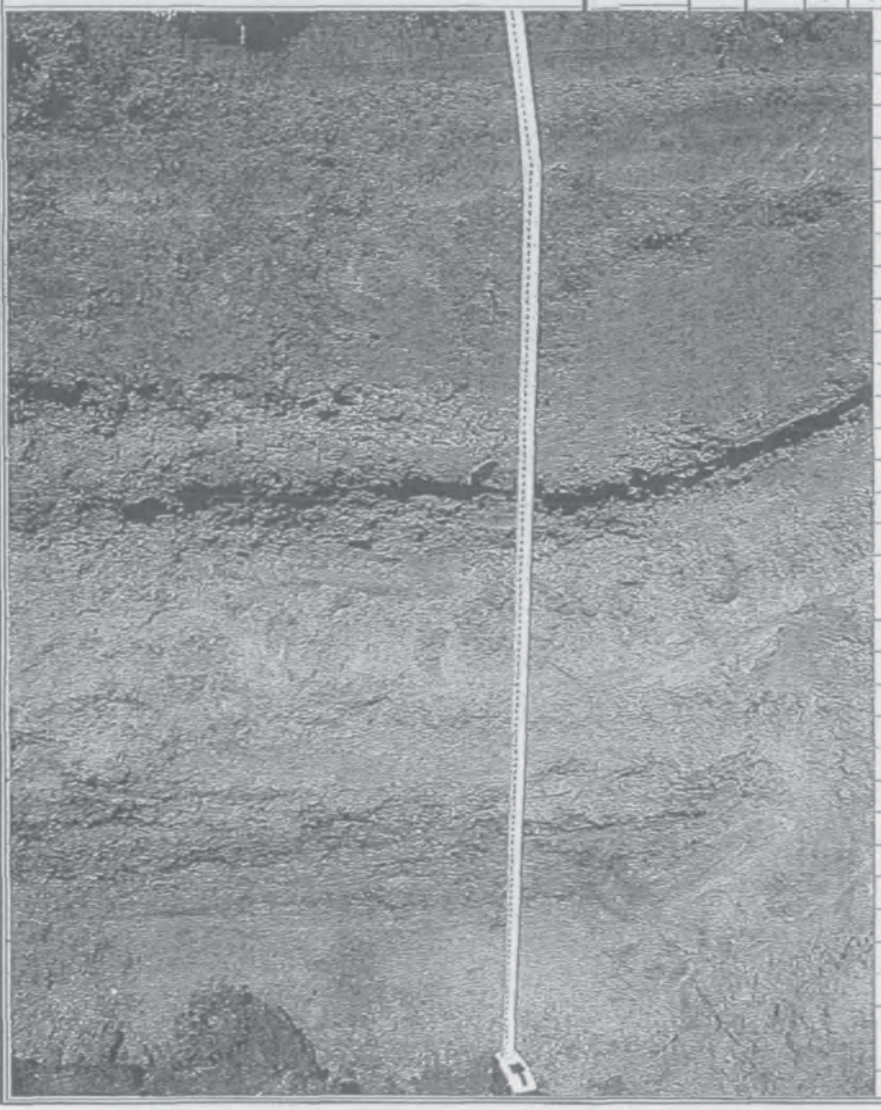
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	22
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Gibbston Valley					
Client:	Gibbston Valley Station					
Hole location:	2187541 E, 5569417 N					
Driller:		Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L:

Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey silt loam , massive structure, firm soil strength, well graded						
tightly packed , fine, medium and coarse schist gravel	ML					
Bitumen	FILL					
grey sandy loam, massive structure, firm soil strength, well graded, firmly packed with fine, medium and coarse schist gravels	SW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

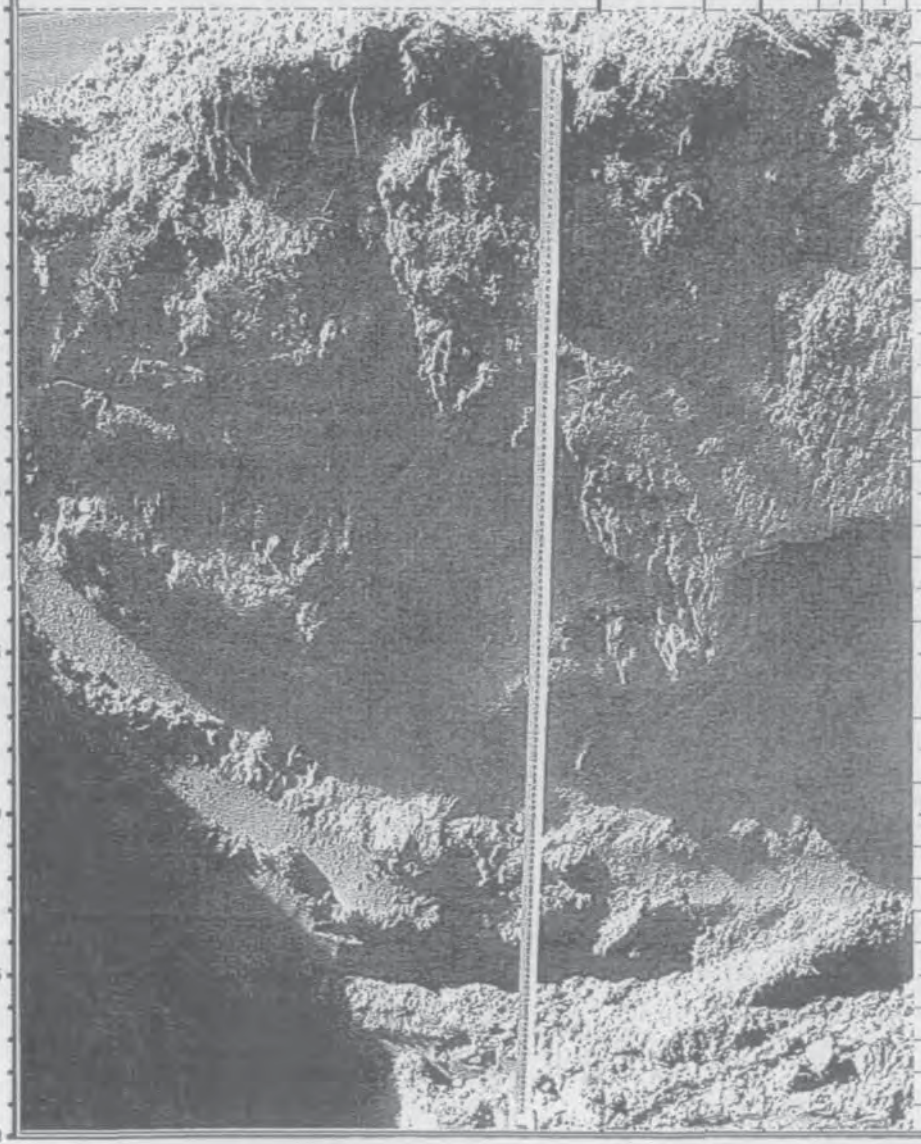
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	23
Job No:	303540
Logged by:	HW
Date drilled:	10/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2187493 E, 5589520 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:

Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey sandy loam, massive structure, firm soil strength, well graded, tightly packed	SW					



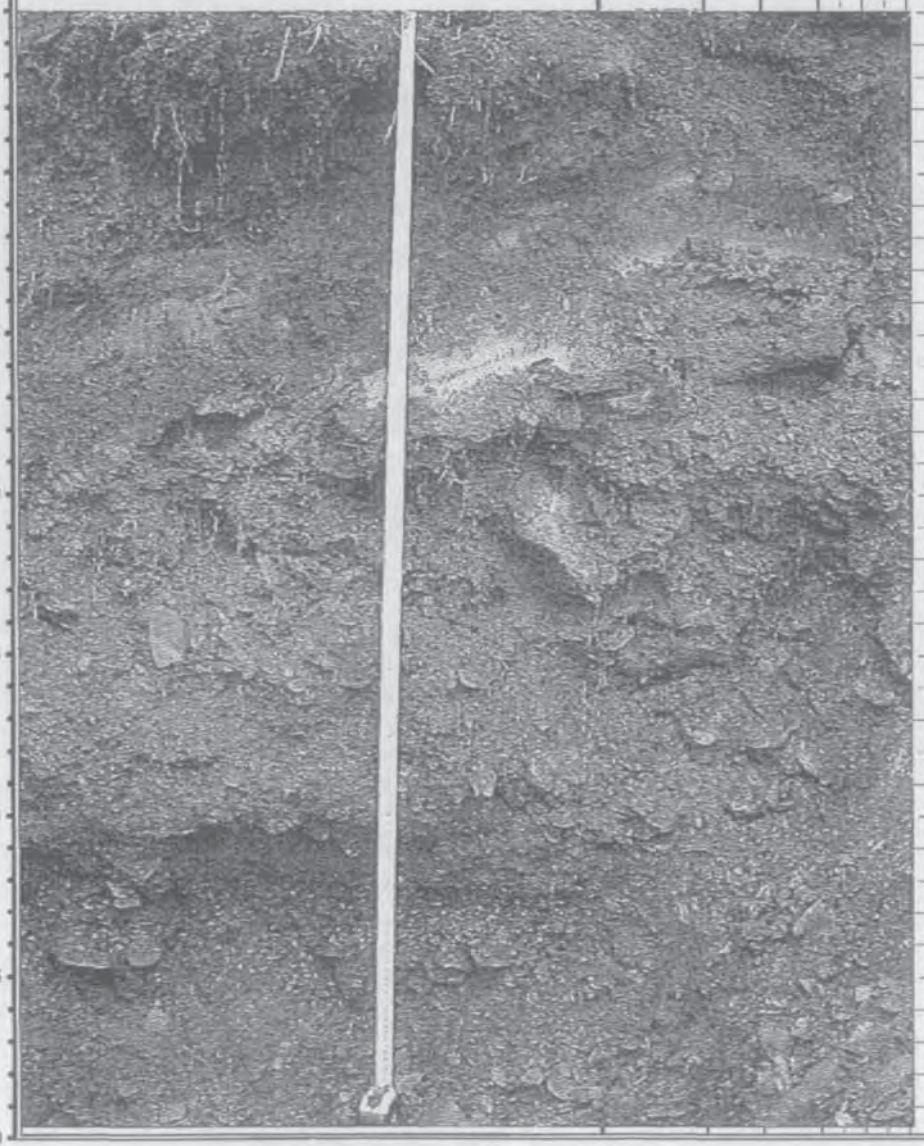
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	24
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2168958 E, 5568982 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
brownish grey silt loam , massive structure, firm soil strength, well graded, tightly packed with fine schist gravels	ML					
grey sandy gravel , massive structure, soft soil strength, well graded, loosely packed with fine, medium and coarse schist gravels	SW					
grey gravel, massive structure, soft soil strength, well graded, loosely packed with fine, medium and coarse schist gravels	GW					

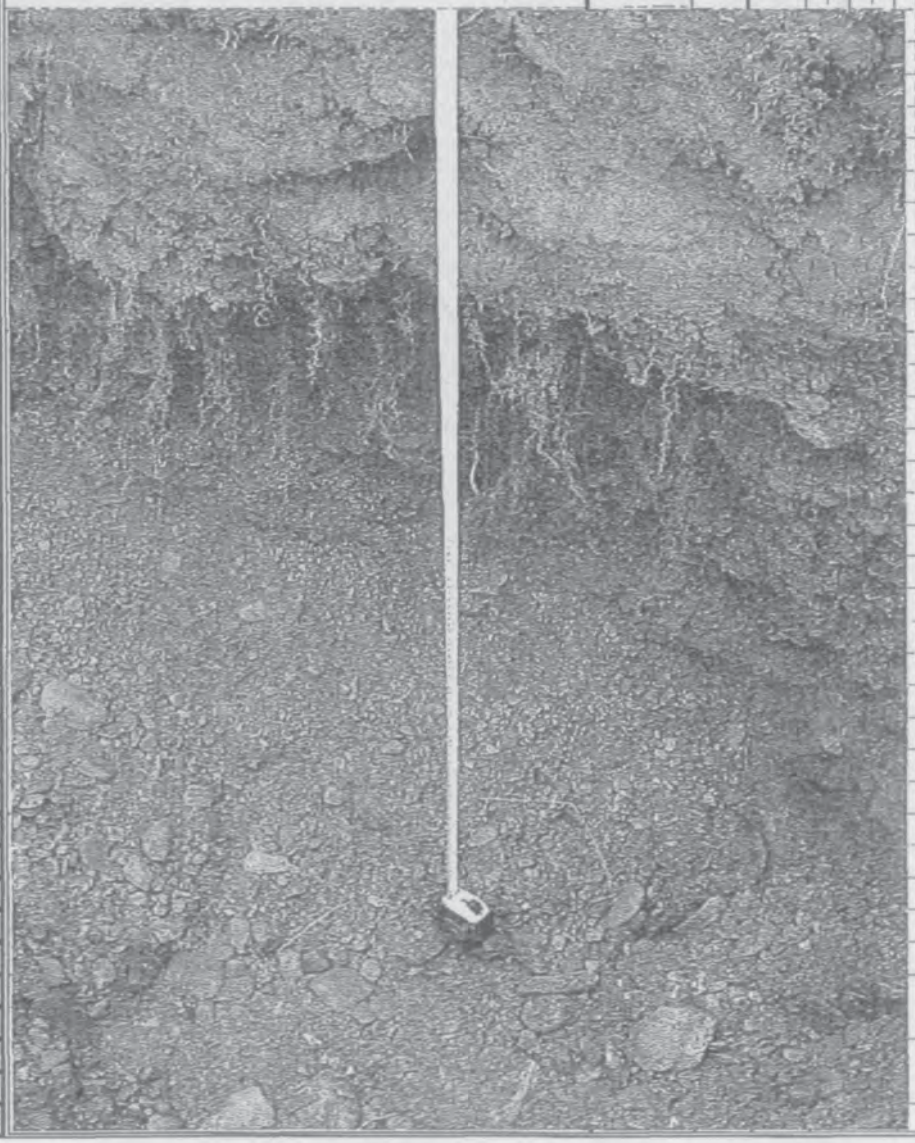


TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	25
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189115 E, 5569045 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML				0 50 100	0 34 50 100 150
brownish grey sandy gravel, massive structure, soft soil strength, graded, loosely packed with fine, medium and coarse schist gravels	SG					
Schist - Bedrock	RX					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

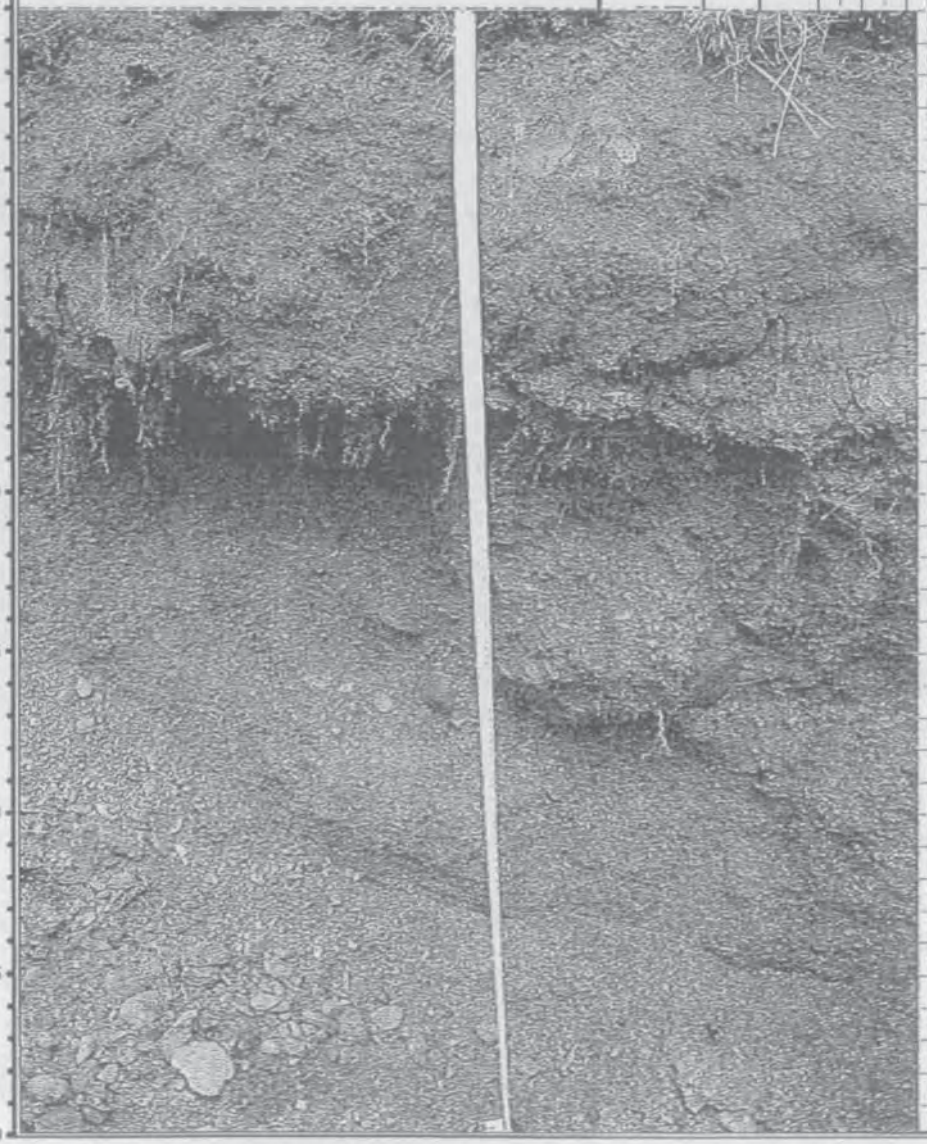
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	26
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189329 E, 5568836 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:

Notes:

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 10% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
brownish grey sandy gravel, massive structure, soft soil strength, graded, loosely packed with fine, medium and coarse schist gravels	SG					



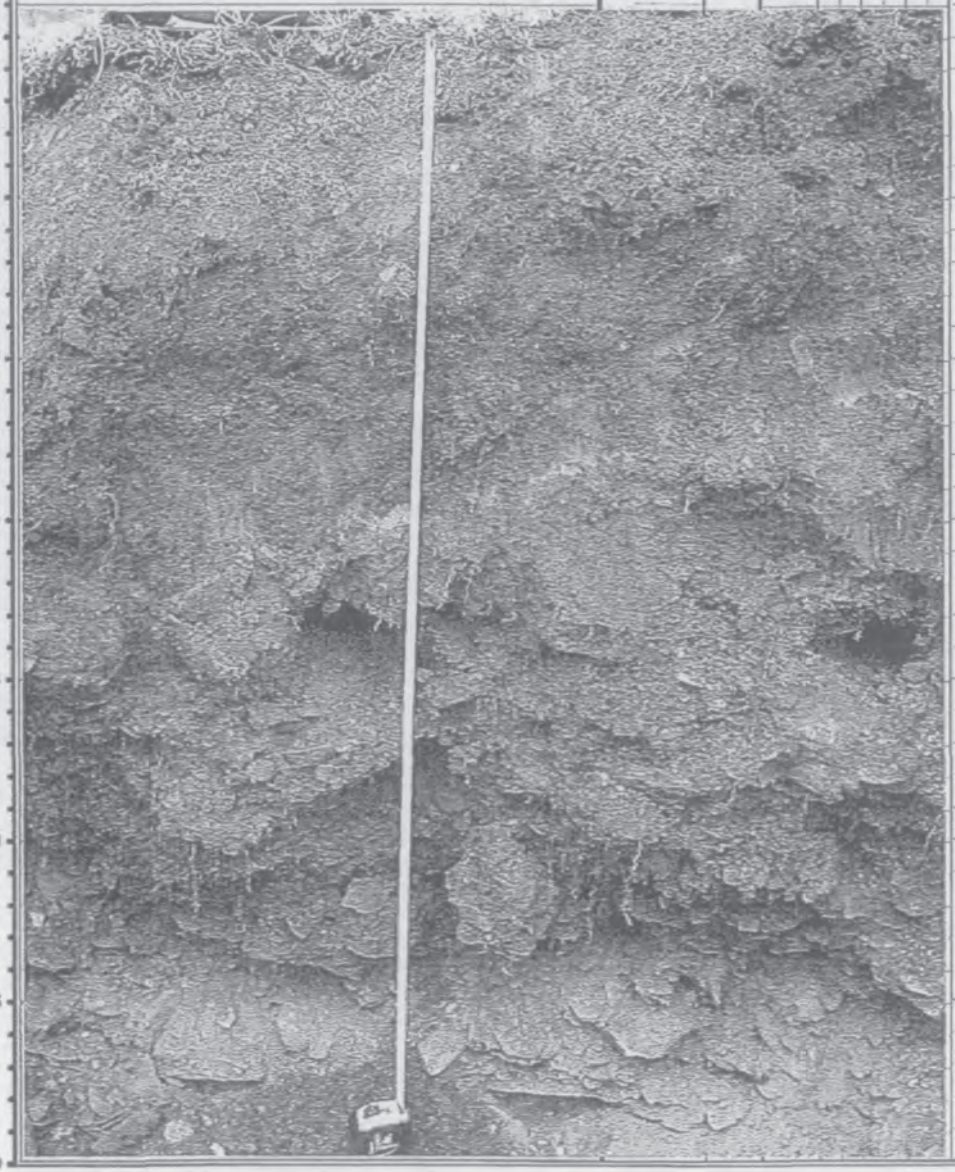
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	27
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.30

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189436 E, 5558588 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 0 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
yellowish brown silty loam, massive structure, firm soil strength, well graded, tightly packed and fine, medium and coarse schist gravels	ML					
grey sandy gravel, massive structure, soft soil strength, well graded loosely packed and fine, medium and coarse schist gravels	SG					
Grey sandy loam, massive structure and soft soil strength, well graded, loosely packed with fine, medium and coarse schist gravels	SW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	28
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.50

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189626 E, 5568579 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

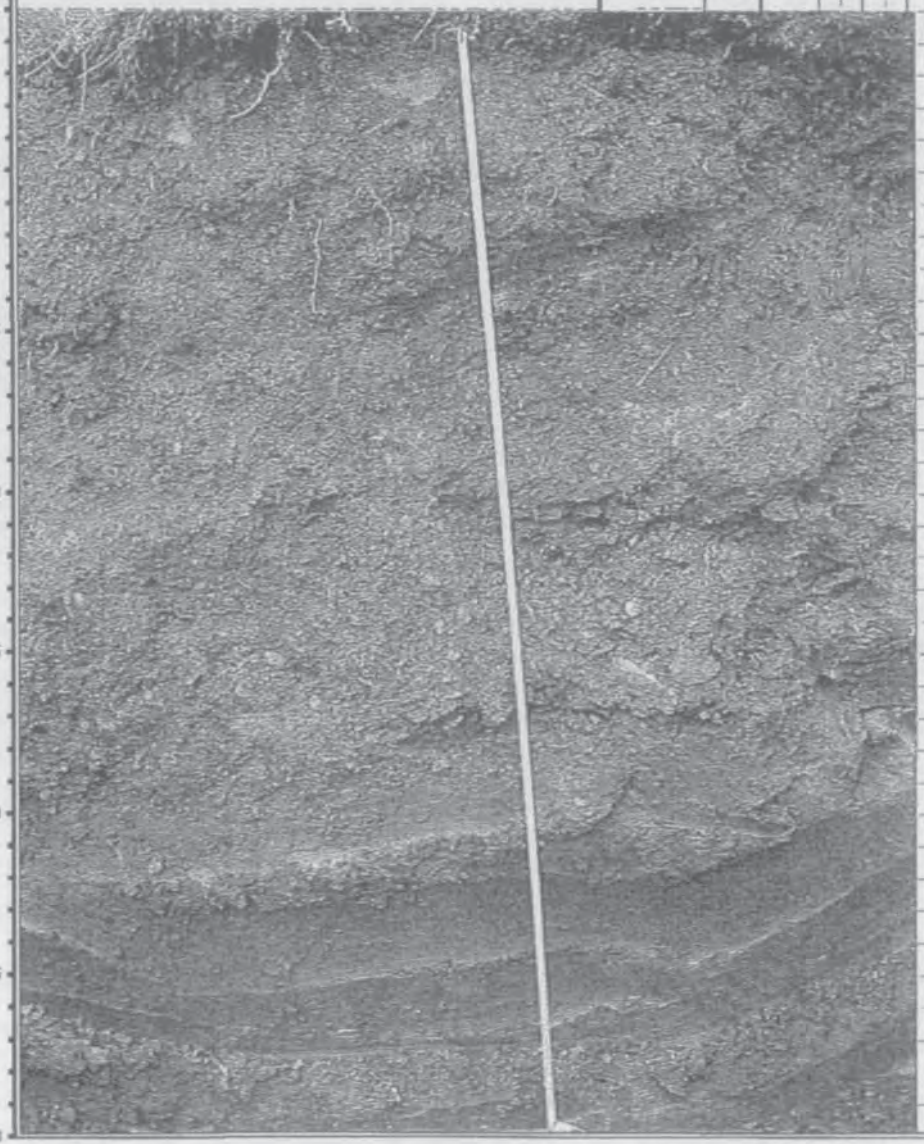
STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected (0–50–100)	SCALA PENETROMETER (mm/blow) (0–34–50–100–150)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
brown silty loam, massive structure, firm soil strength, well graded tightly packed and fine schist gravels	ML					
Grey sandy gravel, 30 % iron staining, massive structure and firm soil strength, well graded, tightly packed with fine, medium and coarse schist gravels	SG					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

TEST PIT LOG
GLASSON POTTS FOWLER LTD

	Project:	Gibbston Valley		Hole No:	29
	Client:	Gibbston Valley Station		Job No:	303540
	Hole location:	2169767 E, 5588567 N		Logged by:	HW
Driller:	Contractor:	Jones Contracting	Equipment: 8 tonne Digger R.L:	Date drilled:	11/10/2007
Notes:				Checked by:	MR
				Date checked:	
				Max depth:	1.40

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected	SCALA PENETROMETER (mm/blow)
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
brown silty loam, massive structure, firm soil strength, well graded tightly packed and fine, medium and coarse schist gravels	SW					
Lense of Schist rock	RX					
Grey sandy loam massive structure and firm soil strength, well graded, tightly packed with fine, medium schist gravels	SW					



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

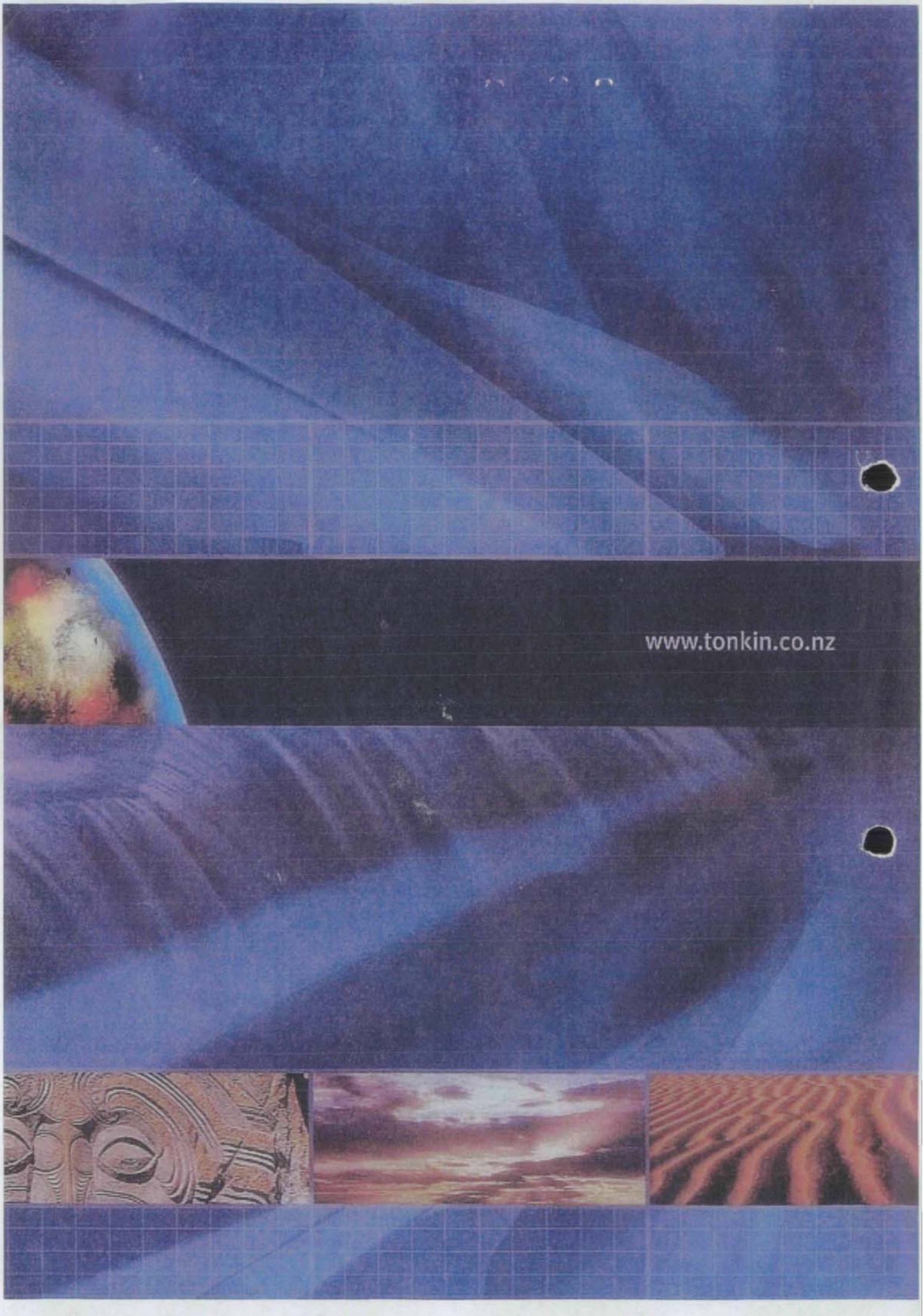
TEST PIT LOG
GLASSON POTTS FOWLER LTD

Hole No:	30
Job No:	303540
Logged by:	HW
Date drilled:	11/10/2007
Checked by:	MR
Date checked:	
Max depth:	1.40

Project:	Gibbston Valley				
Client:	Gibbston Valley Station				
Hole location:	2189962 E, 5568486 N				
Driller:	Contractor:	Jones Contracting	Equipment:	8 tonne Digger	R.L.:
Notes:					

STRATA DESCRIPTION	USCS	Graphic Log	Water Table	Samples	S.P.T N uncorrected 50 100	SCALA PENETROMETER (mm/blow) 0 34 50 100 150
brown silty sand , moist soil with 15% roots, massive structure, well graded, firm soil strength and tightly packed	ML					
grey sandy gravel, massive structure, soft soil strength, well graded, loosely packed with fine, medium and coarse schist gravels	SW					

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0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