

# Geotechnical Report

Laurel Hills Subdivision,  
Ladies Mile, Queenstown

Report prepared for:

Laurel Hills Ltd

Report prepared by:

GeoSolve Limited

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**GEOTECHNICAL**



**WATER  
RESOURCES**



**PAVEMENTS**



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## 1 Introduction

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### 1.1 General

This report presents the results of a geotechnical investigation and assessment undertaken by GeoSolve Ltd to determine the subsoil conditions and provide geotechnical inputs for a proposed subdivision along Frankton Ladies Mile Highway (SH6), Queenstown.



Photo 1 – Site photo looking west across the site.

The investigations were carried out for Laurel Hills Ltd in accordance with GeoSolve Ltd proposal dated 6 September 2018, which outlines the scope of work and conditions of engagement. This report has been prepared to support a sub-division consent application.

### 1.2 Development

Preliminary development concept plans indicate upwards of 100 residential lots will be created with associated access roads and amenity areas. A significant area of cut is proposed in the eastern and southern areas of the site, and areas of fill are expected along the northern boundary. Maximum cut depths are expected to be 8 to 10 m.

The access road is expected to traverse the steep slope in the eastern area of the site, adjoining Stalker Road. Concept drawings, completed by Clark Fortune McDonald & Associated (CFMA), show the proposed extent of earthworks required to form the access road and the intersection with Stalker Road and Maxs Way.

Figure 1, Appendix A, shows the proposed development extents.

## 2 Site Description

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### 2.1 General

The subject property, legally described as Lot 1 DP 431492 and Lot 2 DP 325561 is located south of State Highway 6 (Frankton Ladies Mile Highway) between Lower Shotover bridge and Stalker Road roundabout, approximately 8.8 km from Queenstown township, as shown on Figure 2.1 below.

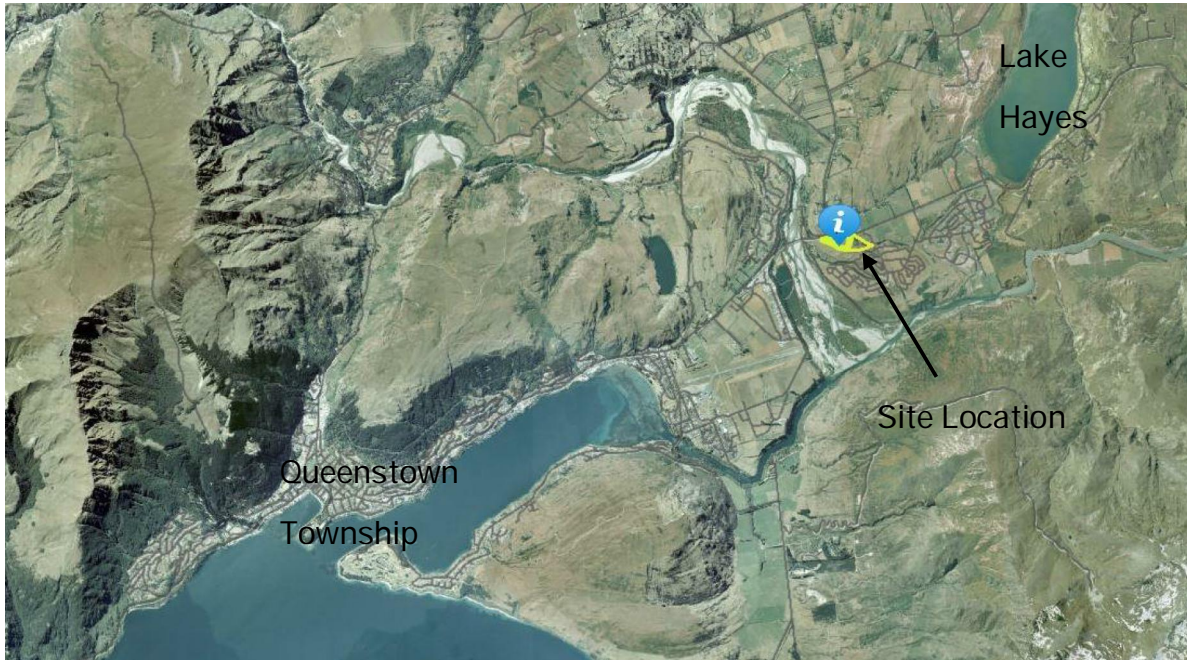


Figure 1 – Site location plan

The property is bounded by Frankton Ladies Mile Highway and 12 Stalker Road to the north, and Stalker Road to the east. Maxs way and rural-residential properties bound the southern and western parts of the site. There is an existing residential dwelling and associated landscaping located in the eastern area of the site. The remainder of the site is currently used as farm land.

### 2.2 Topography and Surface Drainage

The site has been surveyed and the site topography is shown in Figure 1, Appendix A.

The site surface is generally sub-horizontal to gently sloping ( $<5^\circ$ ) to the south, with a landscaping mound trending east-west through the site. Along the southern boundary of the ground falls steeply ( $25-35^\circ$ ) to the south, approximately 7-10m down a historic river terrace riser.

In general the site is naturally free draining and no seepages were evident within the site boundary. An existing retention pond is located within the western area of the site, which was dry at the time of site investigation. A landscaping pond is located within the eastern area of the site, adjacent to the existing dwelling, with standing water. All surface drainage is expected to flow in a southerly direction.





### 3 Geotechnical Investigations

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An engineering geological site appraisal has been undertaken with confirmatory subsurface investigations. Site investigations were undertaken on 30-31 October, 1 November and 12-13 November. The following investigations have been completed:

- 29 test pits which were advanced to a maximum depth of 4.6 m;
- 29 Dynamic cone (Scala) penetrometer tests within the test pits to a maximum depth of 2.3 m;
- 3 soakage tests to assess stormwater soakage potential;
- 5 sonic boreholes to depths of between 10 to 15m with standard penetration testing (SPT);
- Installation of 2 piezometers within the sonic boreholes to monitor groundwater levels.

Test pit and borehole locations and logs are contained in Appendices A and B respectively.



## 4 Subsurface Conditions

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### 4.1 Geological Setting

#### 4.1.1 Regional Geology

The site is in the Wakatipu basin, a feature formed predominantly by glacial advances. Published references indicate the last glacial event occurred in the region between 10,000 and 20,000 years ago. Glaciations have left deposits of glacial till and glacial outwash over ice-scoured bedrock. Post glacial times have been dominated by the erosion of the bedrock and glacial sediment, with deposition of alluvial gravel by local watercourses and lacustrine sediment during periods of high lake levels. The site is located on the historic Shotover River Delta.

Active fault traces were not observed at the site or in the immediate vicinity, and the closest major active fault is the Nevis-Cardrona Fault system. However, significant seismic risk exists in this region from potentially strong ground shaking, associated with the rupture of the Alpine Fault, located 80 km northwest of Queenstown along the west coast of the South Island. There is a high probability that an earthquake with an expected magnitude of over M8 will occur along the Alpine Fault in the next 50 years.

### 4.2 Stratigraphy

The subsurface soils observed during site investigation typically comprised:

- 0.1-0.5m of topsoil, overlying;
- 0.0-1.8m of uncontrolled fill, overlying;
- 0.1-0.45 m of buried topsoil, overlying;
- 0.0-1.3m of colluvium, overlying;
- 0.0-1.3m of loess, overlying;
- 0.0-1.0m of floodplain deposits, overlying;
- Deltaic gravel and sand.

Topsoil was observed at the surface of all test pits and bore holes to depths of between 0.15 and 0.5 m.

Uncontrolled fill was observed to underlie the topsoil in TP 2, 3, 5, 12, 14, 15 and 17 to depths of between 0.35 and 2.3m. The uncontrolled fill comprised loose, sandy GRAVEL with varying components of silt and cobbles, and loose to medium dense, silty SAND with varying components of cobbles, gravel, topsoil and rootlets.

Buried topsoil was observed to underlie the uncontrolled fill in TP 2, 3, 5 and 14 to depths of between 0.35 and 0.8m. The buried topsoil comprised soft, dark brown, organic SILT with varying components of sand and rootlets.

Colluvium was observed to underlie the topsoil in TP 20-22, 24 and 26 to depths of between 0.8 to 1.8m below ground level. The colluvium comprised loose, silty SAND with varying components of gravel and rootlets.



Loess was observed to underlie the topsoil, uncontrolled fill and/or colluvium in TP 1-11, 13-19, 23, 25-29 and BH 1-5, to depths of between 0.5 to 3.0m. The loess comprised loose to medium dense, silty SAND and firm to stiff, sandy SILT with trace of rootlets.

Floodplain deposits were observed to underlie the loess in TP 13-15, 19 to depths of between 1.2 and 3.5m. The floodplain deposits comprise loose, SAND to silty SAND with trace of rootlets and organic horizons.

Deltaic sand and gravel was observed at the base all test pits and bore holes beneath the loess and floodplain deposits, and was observed at depths of between 0.5 and 15 m. The deltaic sand and gravel comprised loose to medium dense, SAND and GRAVEL deposits. The deltaic sand layers comprise sand with variable fractions of silt. These materials extend to depth beneath the whole site.

Full details of the observed subsurface stratigraphy can be found in the test pit logs and borehole logs contained in Appendix B.

An engineering geological model for specific sloping areas of the site is shown in Figures 2a and 2b, Appendix A.

### 4.3 Groundwater

No groundwater seepage was observed in any of the test pits or bore holes during the investigations. Nearby Otago Regional Council (ORC) well data indicates the regional groundwater table is at depths of approximately 40m below current ground levels in the general area. This ties in roughly with the level of the Shotover River, and

### 4.4 Natural Hazards

#### Seismic

A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of the proposed buildings, foundations and associated earthworks.

#### Liquefaction

The site is identified on the Queenstown Lakes District Council (QLDC) Hazard Maps as being 'possibly susceptible' to liquefaction. Our assessment indicates there is very low liquefaction risk for the proposed development due to the significant depth to the regional groundwater table (40 m+). No further assessment is considered necessary with respect to this hazard.

#### Slope Stability

No existing ground instability was identified during the site inspection and no mapped known instability is indicated on the QLDC hazard maps. The potential for localised instability at the crest of the slope present on the southern boundary of the site is discussed in Section 5.8.

No other natural hazards have been identified at the site.





## 5 Engineering Considerations

### 5.1 General

The recommendations and opinions contained in this report are based upon ground investigation data obtained at discrete locations and historical information held on the GeoSolve database. The nature and continuity of subsoil conditions away from the investigation locations are inferred and cannot be guaranteed.

### 5.2 Geotechnical Parameters

Table 5.1 provides a summary of the recommended geotechnical design parameters for the soil materials expected to be encountered during construction of the proposed development.

Table 5.1 – Recommended geotechnical design parameters

Unit	Thickness (m)	Bulk Density $\gamma$ (kN/m <sup>3</sup> )	Effective Cohesion $c'$ (kPa)	Effective Friction $\phi'$ (deg)	Elastic Modulus $E$ (kPa)	Poissons Ratio $\nu$
Topsoil / uncontrolled Fill / Colluvium (soft-firm organic SILT, loose, sandy GRAVEL, loose to medium dense, silty SAND)	0.3-2.3	17	0	32	5-10,000	0.3
Loess (loose, silty SAND and firm to stiff, sandy SILT)	0.0-1.3	18	0	30	5,000	0.3
Floodplain Deposits (loose, SAND and silty SAND)	0.0-1.0	18	0	30	5,000	0.3
Deltaic sand/gravel (loose to medium dense GRAVEL and SAND deposits)	Unknown	19	0	32-34	20,000	0.3

### 5.3 Building Platform Preparation

During the earthworks operations all topsoil, organic matter, fill, colluvium, loess and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZS 4431:1989.

Owing to the moderately erodible nature of some of the soils present across the site, sediment control measures should be instigated during earthworks construction.



Exposure to the elements should be limited for all soils. Excavations in soils should be left proud of the finished subgrade by 200 to 300 mm if a delay prior to construction is expected. The final footing excavation should be performed immediately prior to construction.

Water should not be allowed to pond or collect near or under a foundation slab. Positive grading of the subgrade should be undertaken to prevent water ingress or ponding.

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

We recommend topsoil stripping and subsequent earthworks be undertaken only when a suitable interval of fair weather is expected, or during the earthworks construction season.

## 5.4 Excavations

It is understood that cuts of up to 8m are proposed in the eastern part of the site. This would involve substantial earthworks.

It is expected cut and fill earthworks will be required to establish level building platforms and roads at this site. Deeper excavations may be required for services and infrastructure. Topsoil, fill, colluvium, loess and any soft or unsuitable material should be excavated from beneath all foundation areas.

Recommendations for temporary and permanent soil batter slope angles are described below in Table 5.2. Slopes that are required to be steeper than those described below should be structurally retained or subject to specific geotechnical design.

All slopes should be periodically monitored during construction for signs of instability and excessive erosion, and, where necessary, corrective measures should be implemented to the satisfaction of a geotechnical engineer or engineering geologist.

No seepage was encountered during test pitting. A geotechnical practitioner should inspect any seepage should it be encountered during construction.

Table 5.2 – Recommended batters for permanent cuts up to 3 m in height

Material Type	Recommended Maximum Batter Angles for <u>Temporary</u> Cuts Less than 4 m High (horizontal to vertical)		Recommended Maximum Batter for <u>Permanent</u> Cuts Less than 4 m High in Dry Ground (horizontal to vertical)
	Dry Ground	Wet Ground	
Topsoil, Fill, Colluvium, Loess and Floodplain Deposits	1.5H:1.0V	3.0H:1.0V	3.0H:1.0V
Deltaic gravel/sand	1.5H:1.0V	2.5H:1.0V	2.5H: 1.0V



## 5.5 Engineered Fill Slopes

All fill should be placed and compacted in accordance with the recommendations of NZS4431: 1989 and Queenstown Lakes District Council Standards. All cut and fill earthworks should be inspected and tested as appropriate during construction and certified by a Chartered Professional Engineer.

All un-retained fill slopes which are  $\leq 3.0$  m high should be constructed with a batter slope angle of 2.0H: 1.0V (horizontal to vertical) or flatter and be benched into sloping ground. If a building platform is located at the crest of a slope than batters of 3.0H: 1.0V are recommended in the first instance with an appropriate building set-back.

Fill slopes greater than 3.0 m in height, or that require to be steeper than 2.0H:1.0V, should be subject to geotechnical review.

## 5.6 Ground Retention

### 5.6.1 General

All retaining walls should be designed by a Chartered Professional Engineer using the geotechnical parameters recommended in Table 5.1 of this report. Due allowance should be made during the detailed design of all retaining walls for any additional loads upslope of the wall (i.e. surcharge due to backslope, traffic, buildings and seismic forces).

All temporary slopes for retaining wall construction should be battered in accordance with Table 5.2.

Groundwater was not identified in the test pits or bore holes but has the potential to develop following completion of the earthworks, in particular as a result of heavy or prolonged rainfall. To ensure potential groundwater seeps and flows are properly controlled behind the retaining walls, the following recommendations are provided:

- A minimum 0.3 m width of durable free draining granular material should be placed behind all retaining structures;
- A heavy duty non-woven geotextile cloth, such as Bidim A14, should be installed between the natural ground surface and the free draining granular material to prevent siltation and blockage of the drainage media;
- A heavy-duty (TNZ F/2 Class 500) perforated pipe should be installed within the drainage material at the base of all retaining structures to minimise the risk of excessive groundwater pressures developing. This drainage pipe should be connected to the permanent piped storm water system;
- Comprehensive waterproofing measures should be provided to the back face of all basement retaining walls to minimise groundwater seepage into the finished buildings.

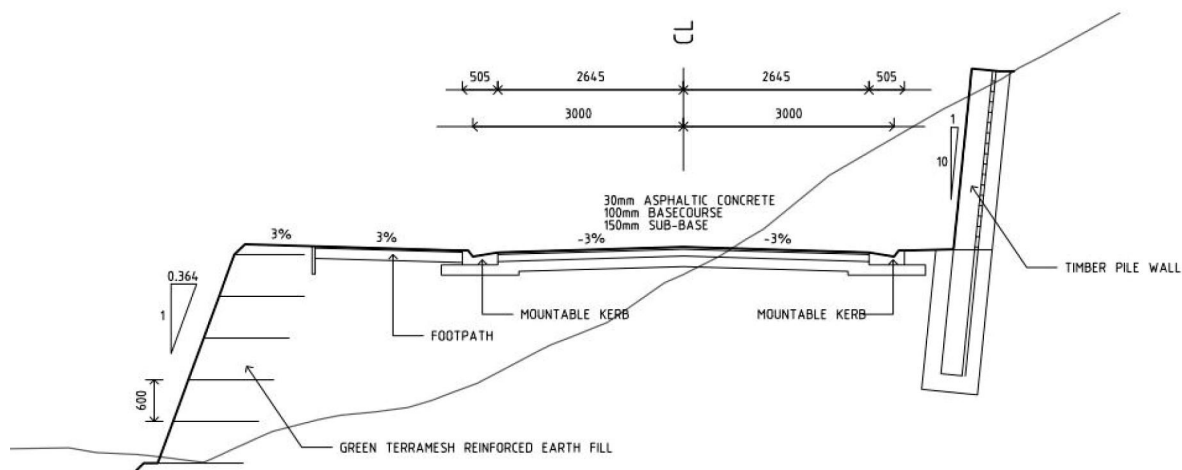
Horizontal drains should be installed to collect and control groundwater flows if excessive groundwater seepages are encountered during construction, but this is considered unlikely. The location and design of all horizontal drains should be confirmed on site by a

Geotechnical Engineer or Engineering Geologist. The outlet of all sub-soil or horizontal drains should be connected to the permanent piped storm water system

### 5.6.2 Access Road

We understand the accessway will traverse the steep slope (approx. 30-35°) in the eastern area of the site, connecting to Stalker Road and Maxs Way. Cut-fill earthworks will be required, with a timber pole retaining wall indicated on the upslope and Terramesh reinforced earth fill downslope side. A typical cross section, completed by CFMA, through the access road is shown on Figure 5.1 below

Table 5.1 – Cross -section through the access road showing general layout and retaining (CFMA)



Fill slopes are indicated to be up to approximately 3.5 m in height and of reinforced earth construction with a Green Terramesh facing. This type of solution is considered to be a suitable method of retention.

For the cut on the upslope side of the road retained heights vary up to approximately 4.5 m at chainage 60, and between chainages 50 and 80 m are typically above 3 m in height. A cantilever timber pole wall is indicated on the drawings. A timber pole is unlikely to be sufficient for the highest sections of cut and a UC wall, possibly with tie backs, is expected to be more suitable. In general, these types of walls are considered appropriate and timber pole walls are expected to be adequate where lower retained heights are present.

Final wall types should be confirmed at the detailed design stage of the project.

## 5.7 Groundwater Issues

The watertable is expected to lie well below the indicated finished floor levels. Dewatering or other groundwater-related construction issues are therefore unlikely to be required. It is



important that GeoSolve be contacted should there be any seepage, spring flow or under-runners encountered during construction.

## 5.8 Slope Stability

Lots will be located close to the crest of the existing slope present along the southern boundary of the site. A slope stability assessment using the software package Slope/W has been completed by Geosolve to determine and appropriate building set-back, and any specific foundation requirements. Table 5.3 below presents the results of the assessment.

Table 5.3 – Minimum Factor of Safety Requirements for various loading cases.

Loading Case	Minimum Factor of safety Requirements	Results
Static	1.5	Factor of Safety satisfied with a 3.5 m set-back from the crest
Seismic Serviceability Limit State (SLS)	1.2	
Seismic Ultimate Limit State (ULS)	N/A (estimated lateral stretch to be restricted to less than 20 mm)	50mm lateral movements calculated within 20 m of the crest

The analysis indicates that 3.5m will provide a suitable building set-back from the crest. To accommodate the potential for lateral stretch within 20 m of the crest during a ULS seismic event it is recommended that houses within this zone are founded on an enhanced foundation system similar to options 2 to 4 described in Section 5.3. of the Ministry of Business, innovation and employment (MBIA) guidance document "Repairing and building houses affected by the Canterbury earthquakes" dated December 2012. Examples of these types of foundations include TC2 rib rafts and waffle slabs. All foundations will require to be specifically designed by a suitably qualified and experienced structural engineer.

If desired specific investigations and slope stability assessments could be undertaken by individual lot owners. A reduction in the set-back distances and foundation recommendations outlined above may be appropriate in some cases.

## 5.9 Foundations

Soil material at typical shallow foundation depths comprises uncontrolled fill, loess, with some pockets of colluvium and floodplain deposits. Deltaic sand and gravels underlie these materials at depths of between 0.7 and 3 m. Where significant cuts are proposed the various surface deposits will be removed and the foundation subgrade will comprise Deltaic sand and gravel materials.

A preliminary summary of the expected foundation bearing capacities across the site are provided below.

It is expected geotechnical completion reporting submitted following sub-division construction will address bearing capacity more thoroughly on a lot by lot basis.



Uncontrolled fill and topsoil, buried topsoil and colluvium— Unsuitable as foundation subgrade materials.

Loess and Flood Plain Deposits— These materials provide low ultimate bearing capacities of approximately 120 – 180kPa, assuming NZS3604 footings, and are typically subject to loss of strength during construction. Specific engineering assessments and undercutting with granular engineered fill is generally undertaken to improve the foundation bearing capacity in these soil types.

Deltaic Sand and Gravel – These materials showed some variability. Good Ground as per NZS3604 will be present in many areas. In some locations ultimate bearing capacities of 210-270 kPa, assuming NZS3604 foundations, were present.

In Summary the results from testing indicate that the ground does not consistently meet the minimum requirements for 'good ground' (i.e. >5 blows per 100 mm) in accordance with NZS3604:2011 within the upper soils.

Typical shallow foundation e.g. strip, pad and waffle slabs will be suitable provided they take into account local bearing capacity variations and are proportioned accordingly. Where weaker soils are present beneath foundation footprints undercutting and replacement with engineered fill compacted in accordance with NZS4431 is also expected to provide a feasible option.

Extending footings, or pile foundations, down to bear on the underlying deltaic sand and gravel, which will provide improved bearing and may be a more cost-effective solution.

Lot specific confirmation of bearing capacity should be provided as per the QLDC guidelines once lot layouts and fill depths have been finalised.

## 5.10 Pavements

Several subdivision roads are included in the scheme. Surface soils in road subgrade areas are expected to comprise silty sand materials (loess and Floodplain Deposits) and deltaic sand and gravel. Design CBR values of 2% on the Loess are recommended for pavement design. A higher CBR of 6% can be obtained on the underlying deltaic sand and gravels. For engineered fill, a CBR of 8-10% is recommended.

Note the loess and Flood plain materials are susceptible to a reduction in strength if subject to saturation or disturbance (trafficking). Care should be taken to stage all pavement construction to enable undisturbed silt materials to be protected as soon as practical following excavation to subgrade levels. A geotextile separation cloth between the silty sand subgrade and the overlying granular pavement layers is recommended as part of future detailed pavement design.

## 5.11 Site Subsoil Category

For detailed design purposes, it is recommended the magnitude of seismic acceleration be estimated in accordance with the recommendations provided in NZS 1170.5:2004.

The site is Class D (deep site) in accordance with NZS 1170.5:2004 seismic provisions. The soil parameters for static conditions given above require no downgrading for seismic





bearing. (The materials are not subject to liquefaction or other strength loss on cyclic loading).

## 5.12 Stormwater Soakage Disposal Assessment

On-site soakage pit testing was undertaken at three locations across the site, as shown in Figure 1, Appendix A.

The test procedure comprised filling an open pit with water up to the maximum level achievable and recording the drop in level over time, i.e. a falling head test. The tests were undertaken at depths of between 1.3 and 1.5m, within deltaic gravel.

The base of the soak pit was then excavated through and the stratigraphy logged by an engineering geologist. Logs are presented in Appendix B.

The static groundwater was not encountered during testing and, based on ORC well logs nearby, is inferred to lie many tens of meters below the site. Calculations indicate that this is sufficiently deep to avoid influencing the soakage test.

The test results are presented in Table 5.4 below.

Soakage design should take into consideration adjacent topography and appropriate setbacks from slope crests should be considered.

Table 5.4. Assessed soakage rates (note all values presented are factored)

Test	Depth (m)	Soil type at base of pit	Factored infiltration rate*	Factored soakage rate**	Maximum volume of water l/m <sup>2</sup> are per event***
Soak 1	1.35	sandy GRAVEL	1,200 mm/hr	20 Litres/m <sup>2</sup> /min	800
Soak 2	1.5	sandy GRAVEL with trace of silt	540 mm/hr	9 Litres/m <sup>2</sup> /min	540
Soak 3	1.3	sandy GRAVEL	1,800 mm/hr	30 Litres/m <sup>2</sup> /min	800
*Includes lateral soakage and a reduction factor of 0.5 to account for loss of soakage performance over time					
**Include some side wall soakage and a reduction factor of 0.5 as above					
***For discharge into ground. Storage within the stormwater system itself will be additional to this.					

## 5.13 QLDC Land Development and Subdivision Code of Practice

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

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



- b) Prior to the detailed planning of any development, to undertake a site inspection and such investigations of subsurface conditions as may be required, and to identify geotechnical hazards affecting the land, including any special conditions that may affect the design of any pipelines, underground structures, or other utility services;
- c) Before construction commences, to review the drawings and specifications defining any earthworks or other construction and to submit a written report to the TA on the foundation and stability aspects of the project (if required);
- d) Before and during construction, to determine the extent of further geo-professional services required (including geological investigation);
- e) Any work necessary to manage the risk of geotechnical instability during the construction process;
- f) Before and during construction, to determine the methods, location, and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work;
- g) During construction, to undertake regular inspection consistent with the extent and geotechnical issues associated with the project;
- h) On completion, to submit a written report (i.e. Geotechnical Completion Report) to the Territorial Authority (TA) attesting to the compliance of the earthworks with the specifications and to the suitability of the development for its proposed use including natural ground within the development area. Where NZS 4431 is applicable, the reporting requirements of that Standard shall be used as a minimum requirement.

This resource consent level report can be considered to have completed items a) and b) from the above list. Once resource consent for the subdivision has been granted a geo-professional will need to be appointed by the developer to review the earthworks drawings and specifications prior to finalising the documentation for tendering and/or construction, and to oversee the construction phase of the project including certification of fill and provide a Geotechnical Completion Report (GCR) and Schedule 2A in accordance with the QLDC CoP.

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

The geo-professional completing the GCR and Schedule 2A which includes the certification of fill should in all cases be engaged by the developer not the contractor. It is also advisable that the geo-professional review the earthworks contract to assist in managing



the developers risk and ensuring that the contract is clear with respect to geotechnical risks and responsibilities during construction.

The use of this report and any of its findings or recommendations as part of the GCR and Schedule 2A may only be used with our prior review and written agreement.



## 6 Neighbouring Structures

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**Distances to adjoining structures:** The site is bounded by residential developments to the south and by Frankton Ladies Mile highway to the north. No adverse geotechnical implications apply for neighbouring developments during construction provided appropriate measures are taken during the construction of the proposed development and the recommendations of this report are followed.

**Aquifers:** The regional ground water table is expected to lie at significant depth beneath the proposed foundation level and no aquifer resource is expected to be adversely affected by the proposed development. Note, the site is located above the Wakatipu aquifer and ORC consent will be required for any drilling/boring undertaken, e.g. for geothermal heating, or further geotechnical investigations.

**Erosion and Sediment Control:** The site presents some potential to generate silt runoff and this would naturally drain downslope. Effective systems for erosion control are runoff diversion drains and contour drains, while for sediment control, options are earth bunds, silt fences, hay bales, vegetation buffer strips and sediment ponds. Only the least amount of subsoil should be exposed at any stage and surfacing established as soon as practical. Details for implementation are given in Appendix B within the following link:

<http://ecan.govt.nz/publications/General/FullErosionandSedimentControlGuideline.pdf>

**Noise:** Standard excavation and compaction plant will be required. QLDC requirements should be met regarding this issue.

**Dust:** The soil materials at the site have potential to generate dust. Regular dampening of soil materials with sprinklers should be effective if required.

**Vibration:** No vibration induced settlement is expected in these soils.



## 7 Conclusions and Recommendations

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- The Geosolve assessment indicates the subject site is suitable for residential development from a geotechnical perspective, provided the recommendations of this report are followed.
- The stratigraphy across the site typically comprises topsoil, fill, colluvium, loess, and floodplain deposits overlying deltaic sand and gravel which extends to depth;
- No groundwater was observed during site investigations and is expected to lie at approximately 40 m beneath the site;
- No liquefaction risks are present at the site.
- Significant earthworks are expected to be undertaken to lower much of the site area. Recommendations for temporary and permanent batter slope angles are described in Table 5.2;
- In general, the surface geology is not consistent and for shallow foundations bearing capacity will vary. Preliminary assessment indicates suitably proportioned foundations or undercut and replacement with engineered fill will provide suitable options. Bearing capacities should be confirmed as part of the Geotechnical completion reporting;
- Extending footings or pile foundations down to bear on a competent layer at depth is expected to be a feasible option, depending on detailed design and assessment;
- Any fill that is utilised as bearing for foundations should be placed and compacted in accordance with NZS 4431:1989 and certification provided to that effect;
- A geotechnical practitioner should inspect all excavations and additionally any seepage, spring flow or under-runners that may be encountered during construction;
- For detailed design purposes, it is recommended the magnitude of seismic acceleration be estimated in accordance with recommendations of NZS 1170.5:2004 using Class D subsoil conditions;
- Slope stability analysis indicates that building setback of 3.5m is required from the crest of the slope and within 20 m of the crest specific foundation types are recommended. See Section 5.8;
- Retaining of the access road cut and fill slope should be undertaken by a chartered professional engineer.
- Pavement and access road subgrades are provided in Section 5.10;
- Soakage to ground is considered acceptable at the site and soakage test results are provided in Section 5.12.
- Geotechnical completion reporting should comply with QLDC requirements as per Section 5.13.



## 8 Applicability

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This report has been prepared for the benefit of Laurel Hills 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.

It is important that we be contacted if there is any variation in subsoil conditions from those described in this report.

Report prepared by:

.....  
Marte Stemland  
Engineering Geologist

Reviewed for GeoSolve Ltd by:

.....  
Paul Faulkner  
Senior Engineering Geologist



# Appendix A: Site Plan & Cross-section



**GEOTECHNICAL**

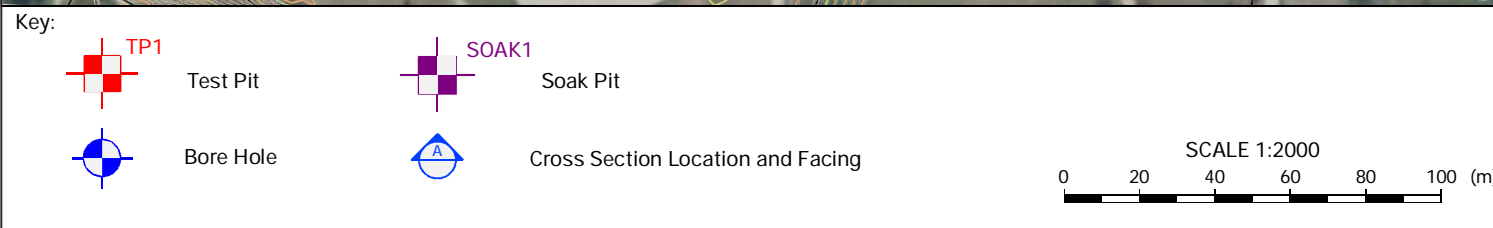
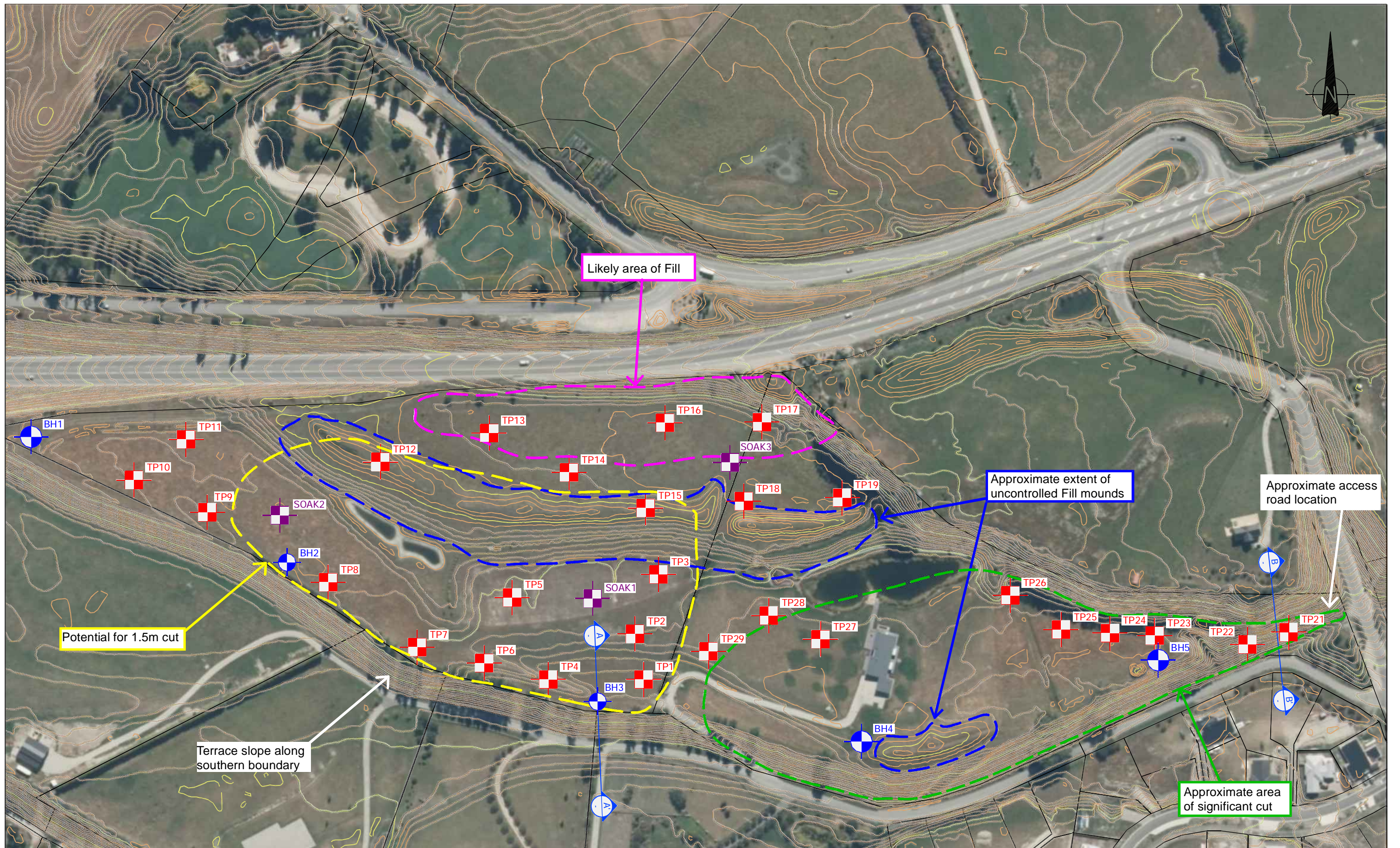


**WATER  
RESOURCES**



**PAVEMENTS**





Level 1, 70 MacAndrew Road, South Dunedin  
www.geosolve.co.nz

DRAWN	WCG	Nov.18
DRAFTING CHECKED	PGF	Dec.18
APPROVED	PGF	Dec.18
CADFILE: 180513_SP.dwg		
SCALES (AT A3 SIZE): 1:2000		
PROJECT No: 180513		FIG No: Figure 1

**Laurel Hills Ltd**

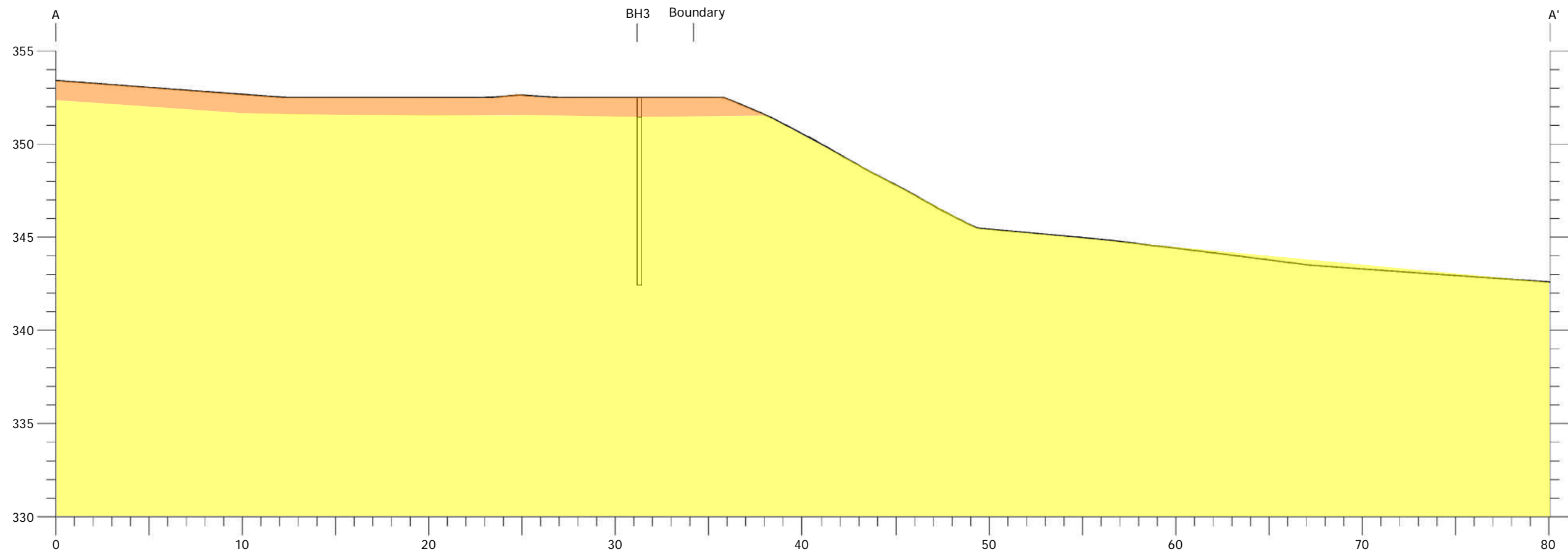
Ladies Mile Subdivision

Lot 1 DP 431492 and Lot 2 DP 325561

Site Investigation Plan

REV. 0





SCALE 1:250  
0 2.5 5.0 7.5 10.0 12.5 (m)

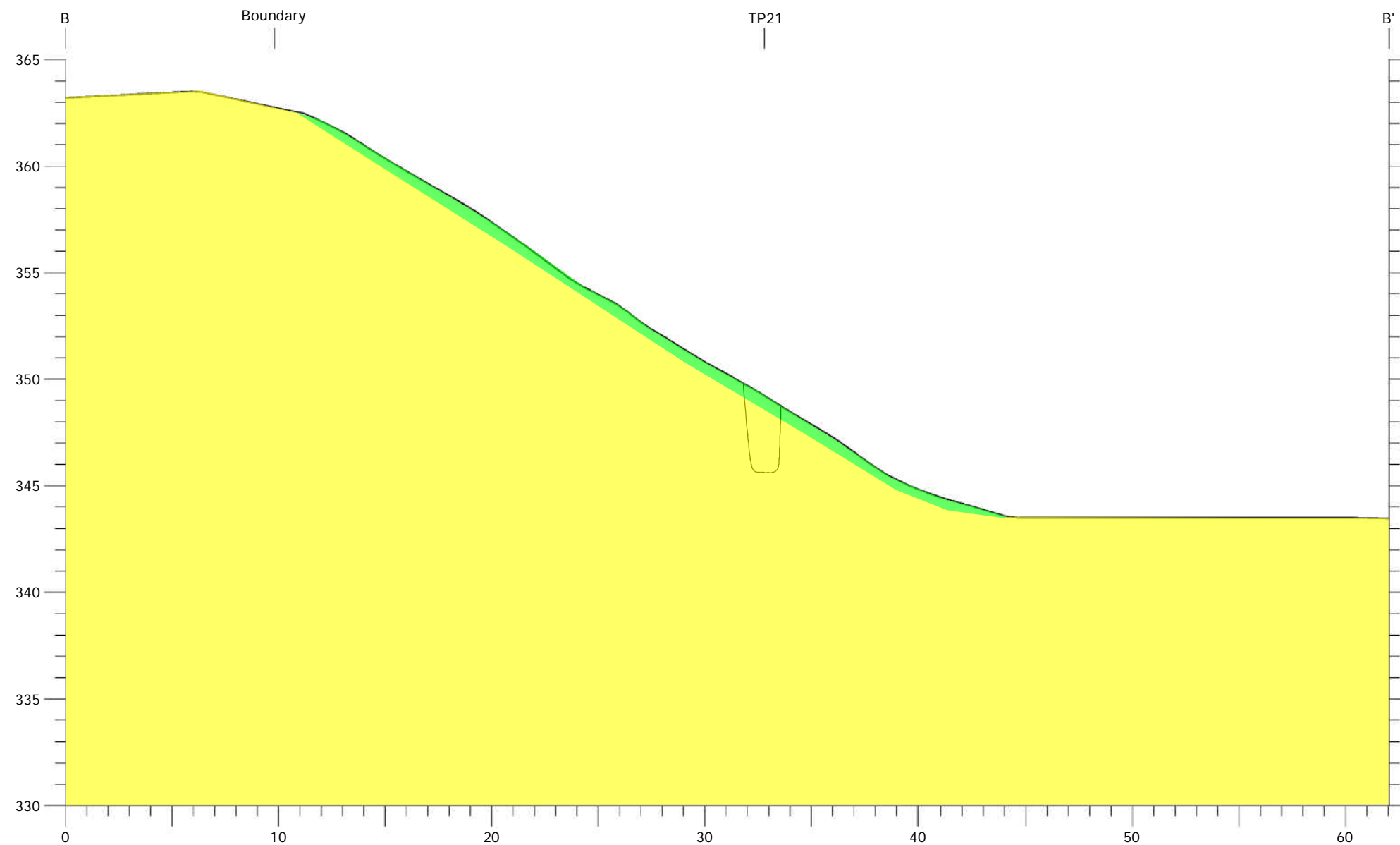
Loess  
Deltaic Sand and Gravel

**GEOSOLVE**  
Level 1, 70 MacAndrew Road, South Dunedin  
www.geosolve.co.nz

DRAWN	WCG	Nov.18
DRAFTING CHECKED	PGF	Dec.18
APPROVED	PGF	Dec.18
CADFILE: 180513_SP.dwg		
SCALES (AT A3 SIZE): 1:250		
PROJECT No: 180513		FIG No: Figure 2a

Laurel Hills Ltd  
Ladies Mile Subdivision  
Lot 1 DP 431492 and Lot 2 DP 325561  
Cross Section A

REV.  
0



SCALE 1:250  
 0 2.5 5.0 7.5 10.0 12.5 (m)

- Topsoil / Colluvium
- Deltaic Sand and Gravel

**G GEOSOLVE**  
 Level 1, 70 MacAndrew Road, South Dunedin  
[www.geosolve.co.nz](http://www.geosolve.co.nz)

DRAWN	WCG	Nov.18
DRAFTING CHECKED	PGF	Dec.18
APPROVED	PGF	Dec.18
CADFILE: 180513_SP.dwg		
SCALES (AT A3 SIZE): 1:250		
PROJECT No: 180513		FIG No: Figure 2b

**Laurel Hills Ltd**  
 Ladies Mile Subdivision  
 Lot 1 DP 431492 and Lot 2 DP 325561  
 Cross Section B

REV.  
0


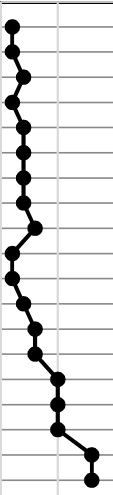
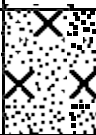

## Appendix B: Investigation Data

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 1

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.9 m

COMMENT: No seepage. Minor slumping from test pit walls	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1


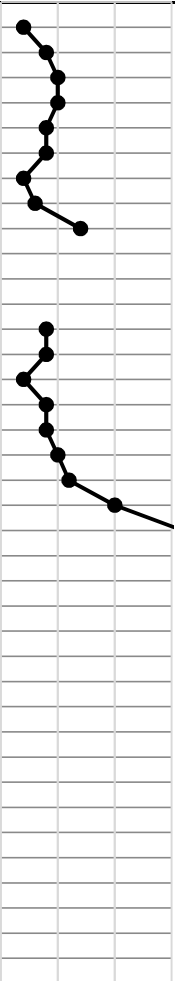






# EXCAVATION LOG

EXCAVATION NUMBER:

TP 2

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.15	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.3	UNCONTROLLED FILL		Greyish brown, sandy GRAVEL. Sand and gravel is fine to coarse. Loose. Massive. M			
0.5	BURIED TOPSOIL		Dark brown, sandy SILT with trace of rootlets. Sand is fine to medium. <i>Firm. Massive. Moist</i>			
0.8	LOESS		Light brown, sandy SILT with trace of rootlets. Sand is fine. Uniformly graded. Firm to stiff. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with sand lenses and trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 3.9 m

COMMENT: No seepage. Walls remained stable during excavation	Logged By: SR
	Checked Date:
	Sheet: 1 of 1



# EXCAVATION LOG

EXCAVATION NUMBER:

TP 3

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.25	TOPSOIL/FILL		Greyish brown, mottled dark brown, gravelly SAND with some organic silt and trace of rootlets. Loose. Moist.		NO SEEPAGE	
0.7	BURIED TOPSOIL		Dark brown, sandy SILT with trace of rootlets. Sand is fine. Firm. Massive. Moist.			
1.2	LOESS		Brown, sandy SILT. Sand is fine. Uniformly graded. Stiff. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with sand lenses and trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 3.9 m


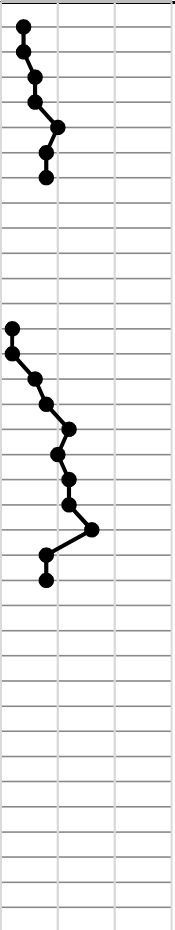


COMMENT: No seepage. Walls remained stable during excavation	Logged By: SR
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 4

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
1.1	LOESS		Light brown, sandy SILT with trace of rootlets and treerots. Sand is fine. Uniformly graded. Stiff. Massive. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose to medium dense. Bedded. Moist. Rootlets to 2.0 m.			

Total Depth = 3.7 m

COMMENT: No seepage. Minor slumping from test pit walls

Logged By: MBS

Checked Date:


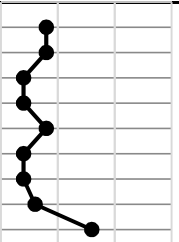

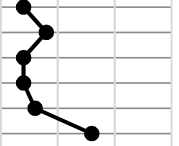

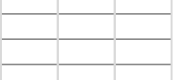

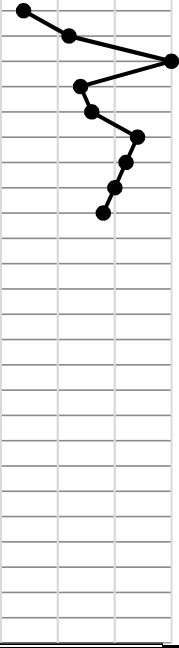
Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 5

PROJECT: Ladies Mile Subdivision		JOB NUMBER: 180513	
LOCATION: See Site Plan		INCLINATION: Vertical	
EASTING:	mE	EQUIPMENT: 14 T excavator	OPERATOR: Jeremy
NORTHING:	mN	INFOMAP NO.	COMPANY: Base Contracting Ltd
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 30-Oct-18
METHOD:		EXCAV. DATUM:	HOLE FINISHED: 30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.2	TOPSOIL/FILL		Dark brown, gravelly sandy organic SILT with trace of rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded. Firm. Moist.		NO SEEPAGE	
0.35	BURIED TOPSOIL		Dark brown, organic SILT with some sand. Sand is fine. Firm. Massive. Moist.			
0.5	LOESS		Light brown, sandy SILT with trace of rootlets. Sand is fine. Uniformly graded. Stiff. Massive. Moist.			
3.8	DELTAIC GRAVEL		Greyish brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 3.8 m


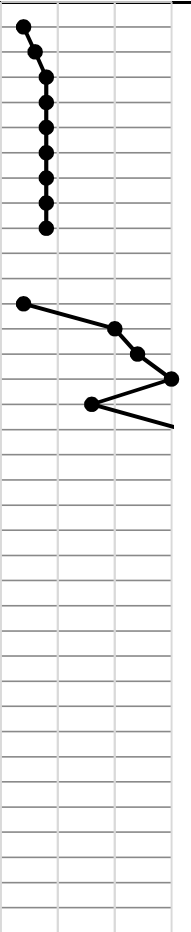
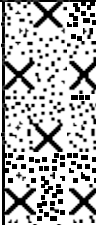

COMMENT: No seepage. Walls remained stable during excavation	Logged By: SR
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 6

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
1.2	LOESS		Light brown, silty SAND with trace of rootlets and treerots. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist. Rootlets to 1.9 m.			

Total Depth = 3.7 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


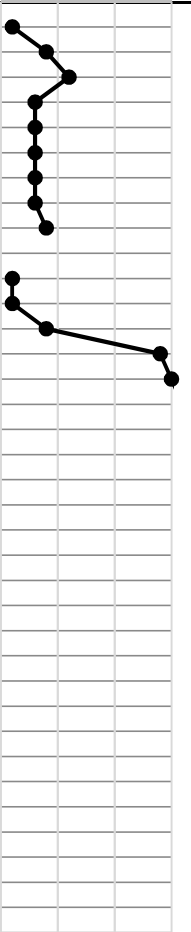
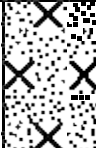

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 7

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.9	LOESS		Light brown, silty SAND. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 300 mm dia. Medium dense. Bedded. Moist.			

Total Depth = 3.7 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:

Sheet: 1 of 1





# EXCAVATION LOG

EXCAVATION NUMBER:

TP 8

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 300 mm dia. Medium dense. Bedded. Moist.			

Total Depth = 3.7 m


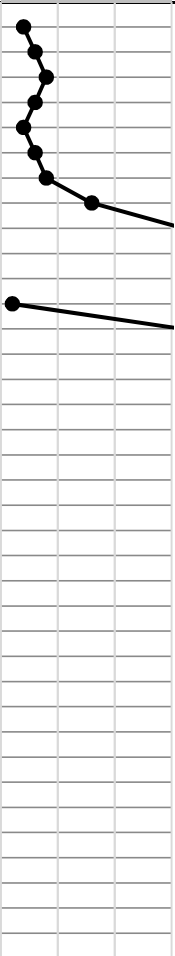
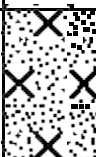

COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 9

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.9	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.8	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 300 mm dia. Medium dense. Bedded. Moist.			

Total Depth = 3.8 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


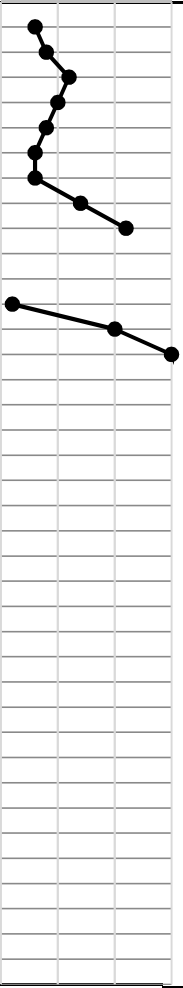
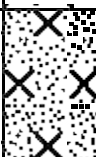

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 10

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.9	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 500 mm dia. Medium dense. Bedded. Moist.			

Total Depth = 3.9 m


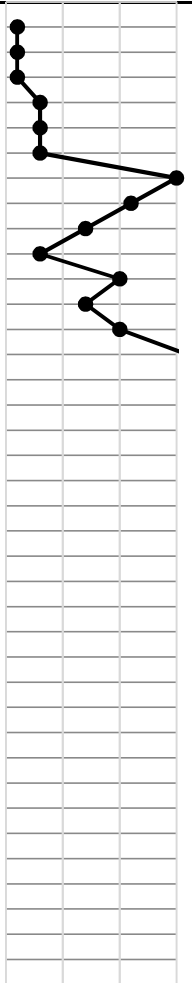


COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 11

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.6	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and trace of boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 300 mm dia. Medium dense. Bedded. Moist.			

Total Depth = 3.9 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


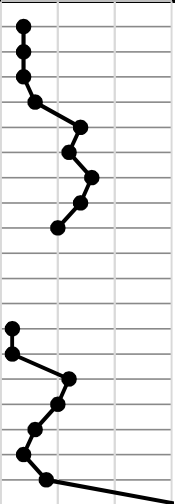


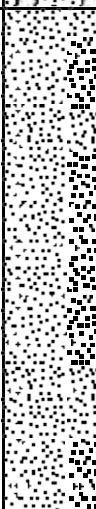

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 12

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	31-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	31-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
2.1	UNCONTROLLED FILL		Brown, silty sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Uniformly graded. Loose to medium dense. Massive. Moist.			
2.2	UNCONTROLLED FILL		Grey, silty sandy GRAVEL. Sand and gravel is fine to coarse. Medium dense.			
4.2	DELTAIC SAND		Grey, SAND with lenses of silty SAND and trace of rootlets. Sand is fine to medium. Iron stains. Loose. Massive. Moist.			
4.6	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.		NO SEEPAGE	

Total Depth = 4.6 m



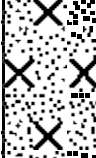




COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 13

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	31-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	31-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
1.0	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.2	FLOODPLAIN DEPOSITS		Light brown, SAND. Sand is fine to medium. Worm holes. Organic horizon 50 mm thick @ 1.0 m depth. Loose. Bedded. Moist.			
2.4	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Loose to medium dense. Bedded. Moist.			
2.7	DELTAIC SAND		Brown grey, SAND. Sand is fine to medium. Loose. Bedded. Moist.			
3.7	DELTAIC SAND/GRAVEL		Brown grey, Interbedded sandy GRAVEL and gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.7 m


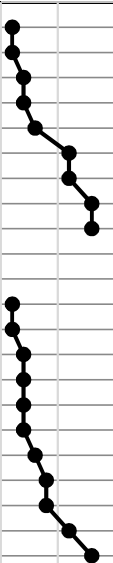





COMMENT: No seepage. Minor slumping from tetrapod pit walls	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 14

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	31-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	31-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.7	UNCONTROLLED FILL		Brown, silty SAND with minor gravel and trace of topsoil, rootlets. Sand is fine. Gravel is fine to coarse, subrounded. Loose. Massive. Moist.			
0.8	BURIED TOPSOIL		Grey brown, organic sandy SILT. Sand is fine. Firm. Moist.			
1.4	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Loose. Massive. Moist.			
2.0	FLOODPLAIN DEPOSITS		Grey, mottled brown and orange, SAND with lenses of silty SAND and trace of rootlets. Sand is fine to medium. Iron stains. Worm holes. Organic horizon 50 mm thick @ 1.4 m depth. Loose. Massive. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.			

Total Depth = 3.9 m

COMMENT: No seepage. Minor slumping from tets pit walls	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1


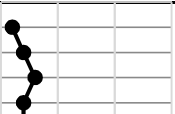
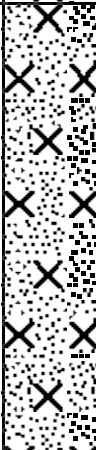
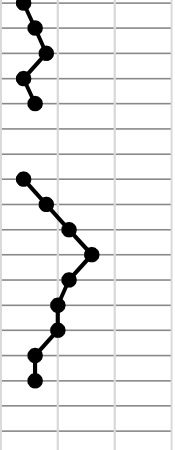
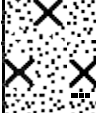
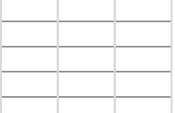
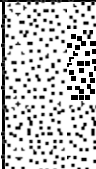
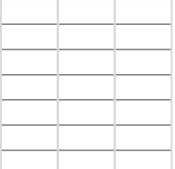

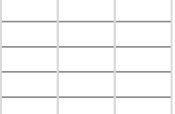


# EXCAVATION LOG

EXCAVATION NUMBER:

TP 15

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	31-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	31-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.5	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
2.3	UNCONTROLLED FILL		Brown, silty SAND with minor gravel and trace of rootlets, topsoil lenses and cobbles. Sand is fine. Gravel is fine to coarse. Gravel and cobbles are subrounded. Loose. Massive. Moist.			
2.8	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Loose. Massive. Moist.			
3.5	FLOODPLAIN DEPOSITS		Grey, mottled brown, SAND. Sand is fine. Worm holes. Organic horizon 50 mm thick @ 3.1m depth. Loose. Massive. Moist.			
4.0	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 4 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


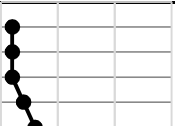
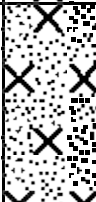
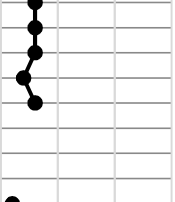
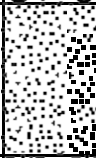
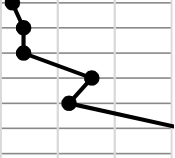

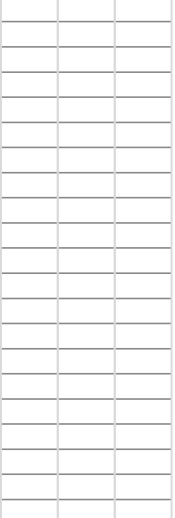
Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 16

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	31-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	31-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.5	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
1.3	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.9	DELTAIC SAND		Brown grey, SAND with some silt and trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
4.0	DELTAIC GRAVEL		Brown grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Loose to medium dense. Bedded. Moist.			

Total Depth = 4 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


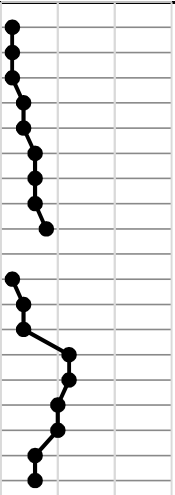

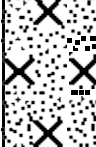


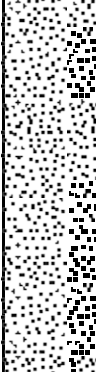

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 17

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.6	UNCONTROLLED FILL		Brown, silty SAND with trace of rootlets. Sand is fine. Loose. Massive. Moist. Irrigation pipe @ 0.5m depth.			
1.3	LOESS		Light brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.4	DELTAIC SAND		Grey, SAND with some silt. Sand is fine. Loose. Weakly laminated. Moist.			
1.5	DELTAIC GRAVEL		Brown, sandy GRAVEL. Sand and gravel is fine to coarse. Loose. Moist.			
3.0	DELTAIC SAND		Grey, SAND with minor gravel. Sand is fine to medium, with trace of coarse grains. Gravel is fine to medium. Iron stains. Loose. Bedded. Moist.			
4.0	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.			

Total Depth = 4 m


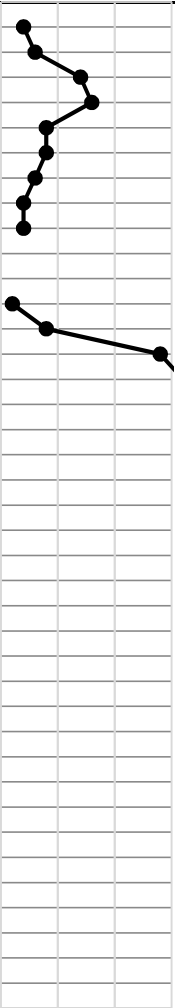
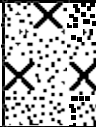
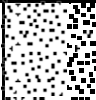

COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 18

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.2	DELTAIC SAND		Brown grey, SAND with minor silt and trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
4.0	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 4 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


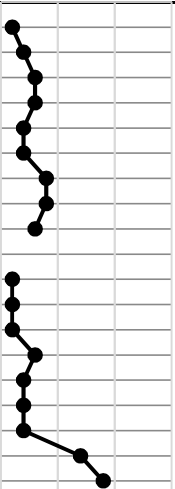

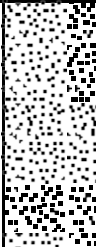

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 19

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.4	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.8	FLOODPLAIN DEPOSITS		Grey, mottled brown, SAND with trace of rootlets. Sand is fine. Organic horizon 50 mm thick @ 1.0 m depth. Discontinuos organic horizon 50mm thick @ 1.3 m depth. Loose. Weakly laminated. Moist.			
3.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.9 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:

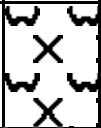
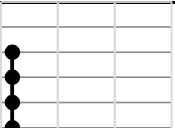

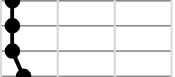

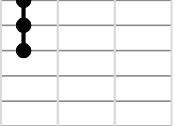

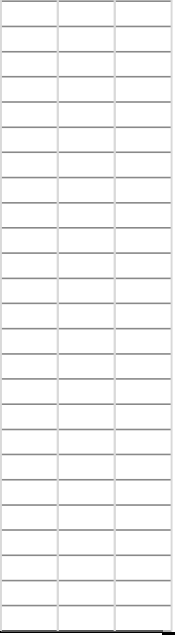
Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 20

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.5	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	COLLUVIUM		Brown, silty SAND with minor gravel and trace of rootlets. Sand is fine. Gravel is fine to medium. Loose. Massive. Moist.			
1.3	DELTAIC GRAVEL		Brown, silty sandy GRAVEL with trace of rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose. Bedded. Moist.			
3.8	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Boulders up to 500 mm dia. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.8 m











COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 21

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets and treerots. Soft. Moist.		NO SEEPAGE	
0.8	COLLUVIUM		Brown, silty SAND with trace of gravel and rootlets. Sand is fine to medium. Gravel is fine to medium. Loose. Moist.			
1.9	DELTAIC GRAVEL		Brown, silty sandy GRAVEL with trace of rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose. Bedded. Moist.			
2.5	DELTAIC GRAVEL		Brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose. Bedded. Moist.			
4.1	DELTAIC GRAVEL		Grey, sandy GRAVEL with sand lenses. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose to medium dense. Bedded. Moist.			

Total Depth = 4.1 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:

Sheet: 1 of 1




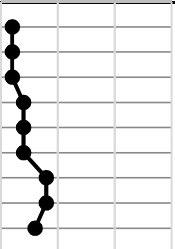
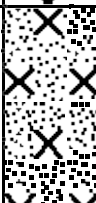


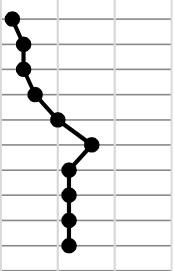
# EXCAVATION LOG

EXCAVATION NUMBER:

TP 22

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						

EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	30-Oct-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	30-Oct-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.2	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
1.0	COLLUVIUM		Brown, silty SAND with trace of gravel and rootlets. Sand is fine to medium. Gravel is fine to medium. Loose. Massive. Moist.			
1.6	DELTAIC GRAVEL		Brown, silty sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose. Weakly bedded parallel to slope. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with sand lenses. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.7 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


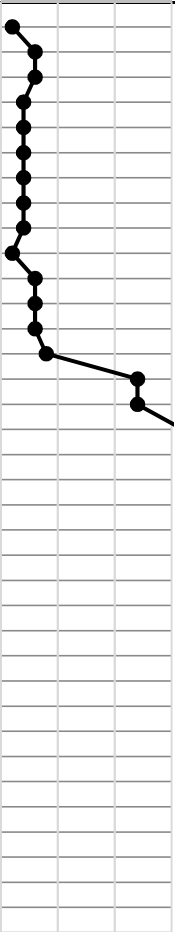
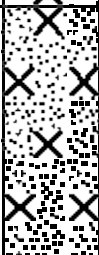

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

**TP 23**

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.5	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Dry.		NO SEEPAGE	
1.5	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Dry.			
3.7	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Dry.			

Total Depth = 3.7 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


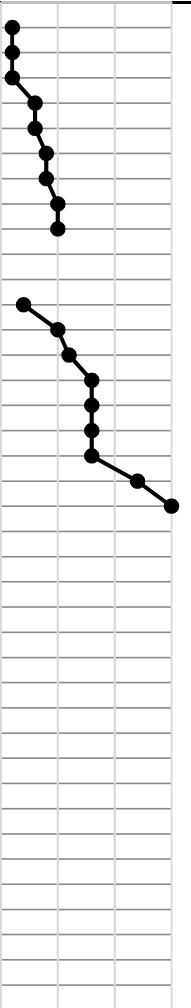
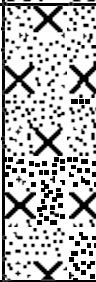
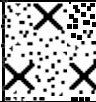

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 24

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180313
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic sandy SILT with trace of rootlets. Soft. Dry.		NO SEEPAGE	
1.4	COLLUVIUM		Brown grey, silty SAND with trace of gravel, rootlets and treeroots. Sand is fine. Gravel is fine to coarse, subrounded to subangular. Loose. Massive. Dry.			
1.8	LOESS		Grey/Brown, silty SAND with trace of rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Dry.			
4.0	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles and silt lenses. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Dry.			

Total Depth = 4 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


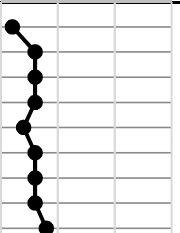
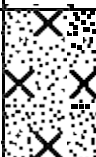

Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 25

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Dry.		NO SEEPAGE	
0.9	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Dry.			
3.8	DELTAIC GRAVEL		Grey/Brown, Interbedded sandy GRAVEL and gravelly SAND with trace of silt lenses and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Dry.			

Total Depth = 3.8 m


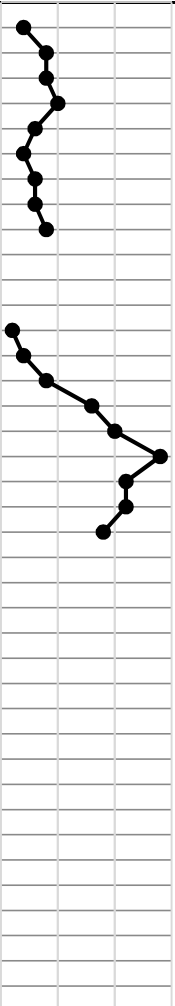
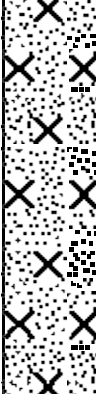
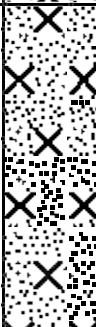

COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 26

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180313
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.1	TOPSOIL		Dark brown, organic SILT with trace of rootlets and treerots. Soft.		NO SEEPAGE	
1.7	COLLUVIUM		Grey brown, silty SAND with some gravel and trace of rootlets, treerots. Sand is fine, with trace medium to coarse. Gravel is fine to coarse, subrounded to subangular. Loose. Dry.			
3.0	LOESS		Yellow brown, silty SAND with trace of rootlets. Sand is fine. Loose to medium dense. Massive. Dry.			
4.0	DELTAIC GRAVEL		Brown grey, Interbedded sandy GRAVEL and gravelly SAND with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Dry.			

Total Depth = 4 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


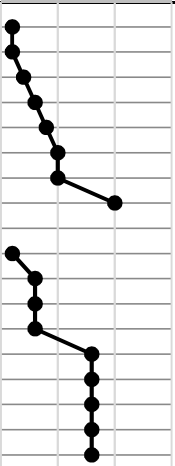


Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 27

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.5	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.9	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.8	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist.			

Total Depth = 3.8 m

COMMENT: No seepage. Walls remained stable during excavation

Logged By: MBS

Checked Date:


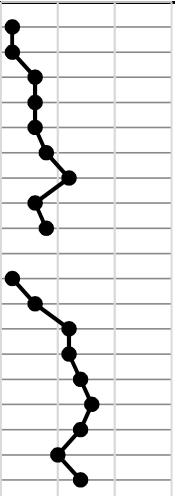
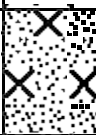



Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

TP 28

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.8	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
0.9	DELTAIC SAND		Grey brown, silty, gravelly SAND. Sand and gravel is fine to coarse. Loose.			
1.1	DELTAIC SAND		Brown grey, SAND with some silt. Sand is fine. Loose. Massive. Moist.			
3.7	DELTAIC GRAVEL		Grey/Brown, Interbedded sandy GRAVEL and gravelly SAND with sand lenses and trace of cobbles, boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles and boulders are subrounded. Loose to medium dense. Bedded. Moist.			

Total Depth = 3.7 m

COMMENT: No seepage. Minor slumping from test pit walls

Logged By: MBS

Checked Date:

Sheet: 1 of 1


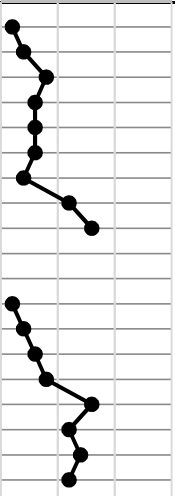
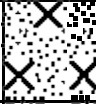



# EXCAVATION LOG

EXCAVATION NUMBER:

TP 29

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.7	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
3.8	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles and rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Loose to medium dense. Bedded. Moist. Rootlets to 1.0 m.			

Total Depth = 3.8 m

COMMENT: No seepage. Minor slumping from test pit walls

Logged By: MBS

Checked Date:




Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

**SOAK 1**

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan			INCLINATION: Vertical		
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.3	UNCONTROLLED FILL		Brown, silty sandy GRAVEL with trace of rootlets. Sand and gravel is fine to coarse, subrounded to subangular. Loose. Massive. Moist.			
2.5	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of cobbles and rootlets. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded. Medium dense. Bedded. Moist. Rootlets to 0.6 m.			

Total Depth = 2.5 m




COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

# EXCAVATION LOG

EXCAVATION NUMBER:

## SOAK 2

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION: Vertical						
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.65	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
2.9	DELTAIC GRAVEL		Grey/Brown, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist. Rootlets to 1.0 m.			

Total Depth = 2.9 m

COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1



# EXCAVATION LOG

EXCAVATION NUMBER:

SOAK 3

PROJECT:	Ladies Mile Subdivision				JOB NUMBER:	180513
LOCATION:	See Site Plan					
INCLINATION:		Vertical				
EASTING:		mE	EQUIPMENT:	14 T excavator	OPERATOR:	Jeremy
NORTHING:		mN	INFOMAP NO.		COMPANY:	Base Contracting Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	1-Nov-18
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	1-Nov-18

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Soft. Moist.		NO SEEPAGE	
0.9	LOESS		Brown, silty SAND with trace of rootlets. Sand is fine. Uniformly graded. Loose. Massive. Moist.			
1.1	DELTAIC SAND		Brown grey, SAND with some silt and trace of rootlets. Sand is fine. Loose. Weakly laminated. Moist.			
3.0	DELTAIC GRAVEL		Brown grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.			


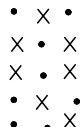
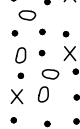

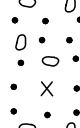



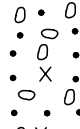
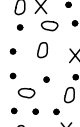
Total Depth = 3 m

COMMENT: No seepage. Walls remained stable during excavation	Logged By: MBS
	Checked Date:
	Sheet: 1 of 1

DRILLHOLE No: BH 1

DRILLHOLE LOG

SHEET ...1..... OF ...1.....

PROJECT: Ladies Mile Subdivision		JOB No: 180513		LOCATION: Ladies Mile, Queenstown		HOLE LOCATION: See Site Plan								
CO-ORDINATES		mN -45.000491045° mE 168.455880485°		DRILL TYPE: Sonic		HOLE STARTED: 12/11/18								
DIRECTION: Vertical		°		DATUM: Ground level		HOLE FINISHED: 12/11/18								
ANGLE FROM HORIZ.: 90°				R.L. GROUND: m		DRILLED BY: Jamie - McNeill								
				R.L. COLLAR: m		LOGGED BY: MBS      CHECKED: PGF								
GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Stregngth/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
TOPSOIL	Dark brown, organic SILT with rootlets.				Soft									
DELTAIC SAND AND GRAVEL	LOESS	Sonic Coring				1								
	Brown grey, silty SAND with trace of rootlets. Sand is fine. Massive													
	Brown grey, gravelly SAND with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT		Very Dense	2			SPT @ 1.5 m 5, 15, 35 Bouncing						
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 80 mm dia.	Sonic Coring			3			SPT @ 3.0 m 9, 11, 24, 26 N = 50 over 130 mm						
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Grey brown from 2.5 m.													
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded to subangular, up to 90 mm dia.	SPT		Very Dense	4			SPT @ 4.5 m 3, 10, 12, 16, 16, 6 N = 50 over 230 mm						
	- Cemented @ 4.4 m.													
	Gren grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Manganese staining.	Sonic Coring			5									
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	Grey, SAND with minor silt. Sand is fine to coarse. Massive.	SPT		Very Dense	6			SPT @ 6.0 m 1, 11, 14, 14, 16, 6 N = 50 over 230 mm						
	Grey, gravelly SAND with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring			7			SPT @ 7.5 m 13, 15, 18, 31, 1 N = 50 over 150 mm						
	Grey, gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Some silt from 7.2 m.													
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT		Very Dense	8									
Grey, SAND with some gravel and minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.														
Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring			9			SPT @ 9.0 m 14, 11, 15, 16, 19 N = 50 over 220 mm							

10

COMMENTS:

Survey Method: Google Earth





DRILLHOLE No: BH 1

SHEET 2 OF 2

Log Scale 1:50

Log Scale 1:50

PROJECT: Ladies Mile Subdivision	JOB No: 180513	LOCATION: Ladies Mile, Queenstown	HOLE LOCATION: See Site Plan
CO-ORDINATES	mN -45.000716293° mE 168.455880485°	DRILL TYPE: Sonic	HOLE STARTED: 12/11/18
DIRECTION: Vertical	°	DATUM: Ground level	HOLE FINISHED: 12/11/18
ANGLE FROM HORIZ.: 90°		R.L. GROUND: m	DRILLED BY: Jamie - McNeill
		R.L. COLLAR: m	LOGGED BY: MBS      CHECKED: PGF

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Sampling Method	Core Recovery (%)	Moisture Content	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box	
	SOIL: Classification, colour, consistency / density, moisture, plasticity									Hammer Efficiency: Borehole Diameter: Liner:						
TOPSOIL	Dark brown, organic SILT with rootlets.		Sonic Coring	100%	Moist	Soft	1				25 50 75					
LOESS	Brown grey, silty SAND with trace of rootlets. Sand is fine. Massive															
DELTAIC SAND AND GRAVEL	Grey brown, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		SPT		Dense	2				SPT @ 1.5 m 2, 3, 3, 9, 11, 12 N = 35			Toby box cemented in place		1	
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		Sonic Coring													
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded to subangular, up to 90 mm dia. - Iron stains @ 3.3 m.		SPT	Very Dense	3	SPT @ 3.0 m 15 Bouncing										
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		Sonic Coring		4											
	White grey, gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cemented.															
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		SPT	Dense	5	SPT @ 4.5 m 7, 9, 9, 9, 9, 10 N = 37										
			Sonic Coring		6											
			SPT	Dense	7	SPT @ 6.0 m 8, 9, 11, 11, 10, 11 N = 43										
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		Sonic Coring		8											
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		SPT	Dense	9	SPT @ 7.5 m 8, 13, 1211, 12, 12 N = 47										
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.		SPT	Dense	9	SPT @ 9.0 m 9, 10, 11, 11, 11, 11 N = 44										
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 70 mm dia.		Sonic Coring													
COMMENTS:																
Survey Method: Google Earth																






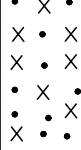
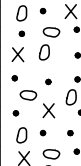

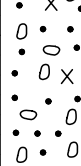
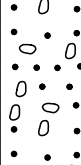
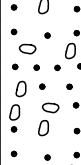
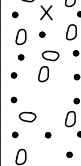
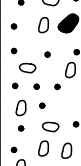

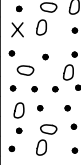
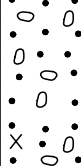
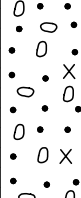
DRILLHOLE No: BH 2

SHEET 2 OF 2

Log Scale 1:50



PROJECT: Ladies Mile Subdivision	JOB No: 180513	LOCATION: Ladies Mile, Queenstown	HOLE LOCATION: See Site Plan
CO-ORDINATES	mN -45.000944913° mE 168.460626445°	DRILL TYPE: Sonic	HOLE STARTED: 12/11/18
DIRECTION: Vertical	°	DATUM: Ground level	HOLE FINISHED: 12/11/18
ANGLE FROM HORIZ.: 90°		R.L. GROUND: m	DRILLED BY: Jamie - McNeill
		R.L. COLLAR: m	LOGGED BY: MBS      CHECKED: PGF

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
TOPSOIL	Dark brown, organic SILT with rootlets.				Soft									
LOESS	Brown grey, silty SAND with trace of rootlets. Sand is fine. Massive	Sonic Coring												
DELTAIC SAND AND GRAVEL	Grey brown, sandy GRAVEL with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Trace of silt from 1.3 m. - Brown grey from 1.5 m.	SPT			Loose	1			SPT @ 1.5 m 3, 3, 2, 2, 2, 2 N = 8					
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				2								
	Grey, sandy GRAVEL with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Trace of silt from 3.0 m.	SPT			Medium Dense	3			SPT @ 3.0 m 3, 3, 3, 5, 4, 4 N = 12					
	Grey, SAND with trace of gravel. Sand and gravel is fine to coarse.													
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				4								
	Brown grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	5			SPT @ 4.5 m 2, 2, 3, 3, 3, 3 N = 12					
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				6								
	Grey brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	7			SPT @ 6.0 m 4, 3, 4, 5, 4, 5 N = 18					
	Grey, sandy GRAVEL with trace of silt and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				8								
	Brown grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Trace of silt from 8.5 m.	SPT			Dense	9			SPT @ 7.5 m 9, 11, 11, 10, 11, 11 N = 43					
	Grey, gravelly SAND with some silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				10			SPT @ 9.0 m 8, 10, 10, 10, 11, 13 N = 44					
COMMENTS: End of Hole @ 10.0 m.														

Survey Method: Google Earth



# DRILLHOLE LOG

SHEET 2 OF 2

DRILLHOLE No: BH 3

PROJECT: Ladies Mile Subdivision		JOB No: 180513	LOCATION: Ladies Mile, Queenstown	HOLE LOCATION: See Site Plan
CO-ORDINATES	mN -45.000944913° mE 168.460626445°	DRILL TYPE: Sonic	HOLE STARTED: 12/11/18	
		DATUM: Ground level	HOLE FINISHED: 12/11/18	
DIRECTION: Vertical	°	R.L. GROUND: m	DRILLED BY: Jamie - McNeill	
ANGLE FROM HORIZ.: 90°		R.L. COLLAR: m	LOGGED BY: MBS	CHECKED: PGF

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
DELTAIC SAND AND GRAVEL	Grey, gravelly SAND with some silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic	100%	Moist		11				25 50 75		Bentonite/Grout		4
		SPT							SPT @ 10.5 m 10, 10, 10, 12, 12, 12 N = 46					
						11								
						12								
						13								
						14								
						15								
						16								
						17								
						18								
						19								
COMMENTS:														


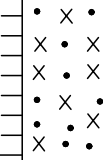
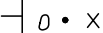
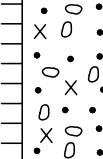
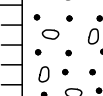
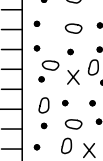
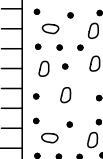
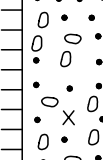
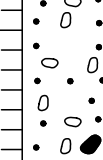
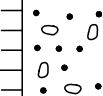
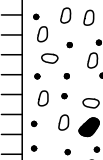
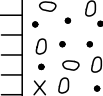
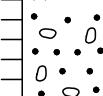
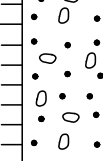
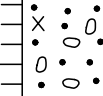
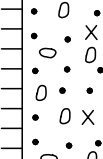
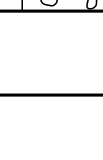
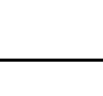

Survey Method: Google Earth

Log Scale 1:50

**Survey Method:** Google Earth

Log Scale 1:50

PROJECT: Ladies Mile Subdivision	JOB No: 180513	LOCATION: Ladies Mile, Queenstown	HOLE LOCATION: See Site Plan
CO-ORDINATES	mN -45.001034551° mE 168.461382666°	DRILL TYPE: Sonic	HOLE STARTED: 13/11/18
DIRECTION: Vertical	°	DATUM: Ground level	HOLE FINISHED: 13/11/18
ANGLE FROM HORIZ.: 90°		R.L. GROUND: m	DRILLED BY: Jamie - McNeill
		R.L. COLLAR: m	LOGGED BY: MBS      CHECKED: PGF

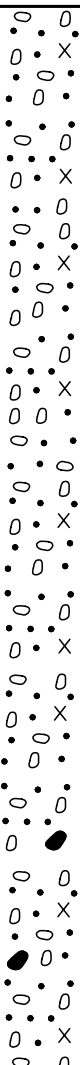
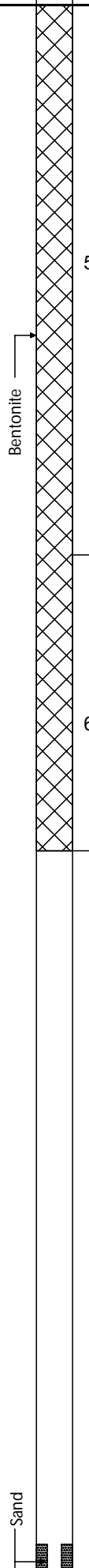
GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Stregngth/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
TOPSOIL	Dark brown, organic SILT with rootlets.				Soft									
LOESS	Brown grey, silty SAND with trace of rootlets and worm holes. Sand is fine. Massive	Sonic Coring				1								
DELTAIC SAND AND GRAVEL	Grey, SAND with some silt. Sand is fine. Thinly laminated.													
	Brown grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Loose	2			SPT @ 1.5 m 3, 3, 2, 2, 2, 2 N = 8					
	- Trace of cobbles from 1.95 m. Cobbles are subrounded.													
	Grey, sandy GRAVEL with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				3								
	Brown grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	4			SPT @ 3.0 m 3, 3, 3, 5, 4, 4 N = 12					
	Brown grey, sandy GRAVEL with trace os fillt and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 70 mm dia.	Sonic Coring				5								
	Brown grey, gravelly SAND with some silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	6			SPT @ 4.5 m 2, 2, 3, 3, 3, 3 N = 12					
	- Gravel is fine to medium from 4.5 m.													
	Grey, sandy GRAVEL with trace of silt and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 80 mm dia.	Sonic Coring				7								
	Grey, sandy GRAVEL with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	- Some silt from 5.7 m.													
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	8			SPT @ 6.0 m 4, 3, 4, 5, 4, 5 N = 18					
	- Minor silt from 7.3 m.													
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Dense	9			SPT @ 7.5 m 9, 11, 11, 10, 11, 11 N = 43					
	Grey, gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring				10								
	Grey, sandy GRAVEL with trace of cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 80 mm dia.													
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Dense				SPT @ 9.0 m 8, 10, 10, 10, 11, 13 N = 44					
		Sonic Coring												
COMMENTS:														

Survey Method: Google Earth

DRILLHOLE No: BH 4


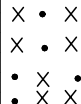




















DRILLHOLE LOG

SHEET ..2.... OF ...2.....

PROJECT: Ladies Mile Subdivision		JOB No: 180513		LOCATION: Ladies Mile, Queenstown		HOLE LOCATION: See Site Plan								
CO-ORDINATES		mN -45.001034551° mE 168.461382666°		DRILL TYPE: Sonic		HOLE STARTED: 13/11/18								
DIRECTION: Vertical		°		DATUM: Ground level		HOLE FINISHED: 13/11/18								
ANGLE FROM HORIZ.: 90°				R.L. GROUND: m		DRILLED BY: Jamie - McNeill								
				R.L. COLLAR: m		LOGGED BY: MBS      CHECKED: PGF								
GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Stregngth/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
DELTAIC SAND AND GRAVEL	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Some silt from 10.3 m.  - Trace of silt from 10.5 m.	Sonic	100%	Moist	Very Dense	11				25 50 75				5
		SPT							SPT @ 10.5 m 35 Bouncing					
	Grey, SAND with some gravel. Sand is fine to coarse. Gravel is fine to medium. Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. - Trace of cobbles from 11.4 m.	Sonic Coring												
	Brown grey, gravelly SAND with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Grey, SAND with minor gravel. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Brown grey, gravelly SAND with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT							SPT @ 12.0 m 30 Bouncing					
		Sonic Coring												
	Grey, sandy GRAVEL with trace of silt and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded, up to 70 mm dia.	SPT							SPT @ 13.5 m 18, 21, 24, 26 N = 50 over 110 mm					
		Sonic Coring												
		SPT							SPT @ 15.0 17, 13, 18, 21, 11 N = 50 over 165 mm					
	End of Hole @ 15.38 m.					16								
						17								
						18								
						19								
						20								
COMMENTS:														
Survey Method: Google Earth														



PROJECT: Ladies Mile Subdivision	JOB No: 180513	LOCATION: Ladies Mile, Queenstown	HOLE LOCATION: See Site Plan
CO-ORDINATES	mN -45.000865817° mE 168.462075710°	DRILL TYPE: Sonic	HOLE STARTED: 13/11/18
DIRECTION: Vertical	°	DATUM: Ground level	HOLE FINISHED: 13/11/18
ANGLE FROM HORIZ.: 90°		R.L. GROUND: m	DRILLED BY: Jamie - McNeill
		R.L. COLLAR: m	LOGGED BY: MBS      CHECKED: PGF

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Content	Stregngth/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING	Water Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity								Hammer Efficiency: Borehole Diameter: Liner:					
TOPSOIL	Dark brown, organic SILT with rootlets.				Soft									
LOESS	Grey brown, silty SAND with trace of rootlets and worm holes. Sand is fine. Massive	Sonic Coring												
DELTAIC SAND AND GRAVEL	Grey brown, sandy GRAVEL with some silt. Sand and gravel is fine to coarse.	Sonic Coring			Loose	1			SPT @ 1.5 m 8, 5, 6, 6, 6, 6 N = 24					1
	Grey brown, SAND with trace of silt and gravel. Sand is fine to medium with trace of coarse. Gravel is fine.													
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT												
	- Grey brown from 1.5 m.													
	- Grey from 1.95 m.	Sonic Coring				2								
	- Trace of silt and cobbles from 2.7 m.													
	Brown grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	3			SPT @ 3.0 m 5, 2, 4, 4, 4, 4 N = 16					
	Grey, sandy GRAVEL with trace of silt and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded to subangular, up to 70 mm dia.	Sonic Coring				4								2
	- Minor silt from 4.1 m.													
	- Some silt from 4.3 m.	SPT			Medium Dense	5			SPT @ 4.5 m 4, 4, 5, 5, 4, 5 N = 19					
	Grey, sandy GRAVEL with minor cobbles and trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded to subangular, up to 70 mm dia.	Sonic Coring				6								
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Medium Dense	7			SPT @ 6.0 m 5, 7, 8, 8, 8, 9 N = 33					3
	Grey, sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Cobbles are subrounded to subangular, up to 70 mm dia.	Sonic Coring				8								
	- Trace of silt from 7.3 m.													
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	SPT			Dense	9			SPT @ 7.5 m 9, 9, 9, 10, 10, 9 N = 38					
	- Trace of cobbles from 8.3 m.	Sonic Coring				10								
	Grey, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.													
	- Minor silt from 8.8 m.	SPT			Dense				SPT @ 9.0 m 10, 6, 7, 8, 8, 8 N = 31					4
	Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular.	Sonic Coring												
	- Sand is fine to coarse, trace of silt from 9.8 m.													
COMMENTS:														



DRILLHOLE No: BH 5

SHEET 2 OF 2

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