

GTE774-R01 Rev1

7 April 2016

**ESQ1818 PANTHERS Pty Ltd**

PO Box 6924

Baulkham Hills NSW 2153

Attention: Joe Bevacqua

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Dear Sir,

**RE: Geotechnical Investigation at Panthers North Precinct, Mulgoa Road, Penrith NSW.**

This letter presents a report on the inspection and testing services associated with the geotechnical investigation at the above mentioned location.

Should you have any questions related to this report please do not hesitate to contact the undersigned.

For and on behalf of

**Ground Technologies Pty Ltd**

**Reviewed By**



J. Harendran

*Geotechnical Engineer*



A. Bennett

*Senior Geotechnical Engineer*

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## 1. INTRODUCTION

Ground Technologies Pty Ltd (Ground Tech) has prepared this report to discuss the results of the geotechnical investigation for the site at Panthers North Precinct, Mulgoa Road, Penrith NSW (herein referred to as the "site"). Ground Tech was engaged to provide professional assistance for this component of the project.

The preliminary geotechnical investigation included drilling sixteen (16) boreholes using Ground Technologies 4WD Toyota Landcruiser Solid Flight Auger Drill Rig, and ten (10) boreholes using a track mounted Hanjin D&B drilling rig. Standard Penetration Testing (SPT) was undertaken within selected boreholes and three groundwater monitoring wells were installed. Borehole locations are shown on Figure 1 in Appendix A.

This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site.

## 2. SITE DETAILS

The following information, presented in Table 1, describes the site.

**Table 1: Summary of Site Details**

<b>Site Address</b>	Panthers North Precinct, Mulgoa Road, Penrith
<b>Lot / DP</b>	Part Lot 1 DP1043008 Lot 1 DP1064526 Lot 1021 DP812335
<b>Council Area</b>	Penrith Council
<b>Owner/Developer</b>	ESQ1818 Panthers Pty Ltd

### 2.1 Geology

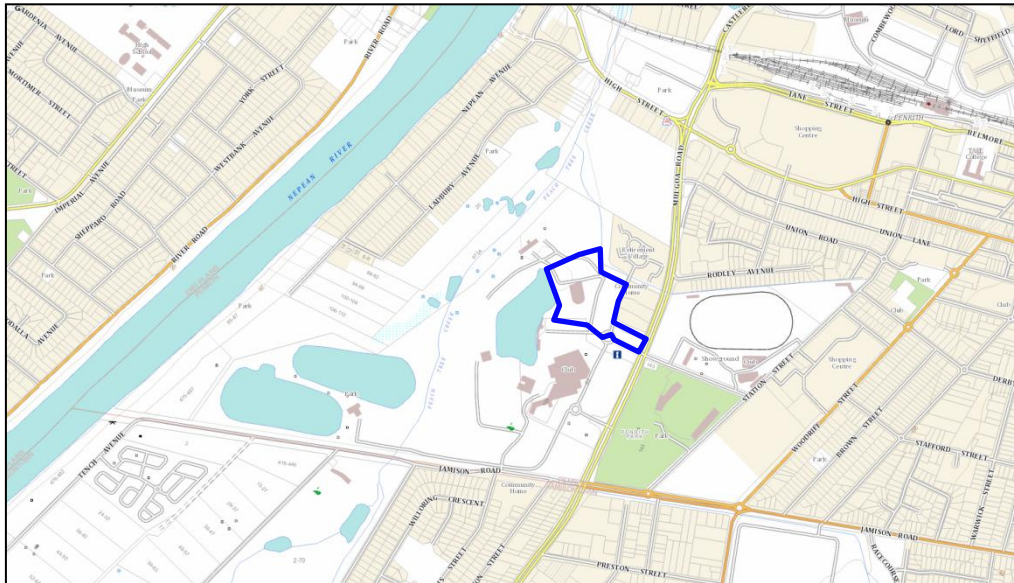
The 1:100,000 scale Geological Series Map of the Penrith region indicates that the subject site is underlain by alluvial gravel, sand, silt and clay of the Cranebrook Formation.

### 2.2 Site Description

The site is located on the western side of Mulgoa Road in Penrith, and is a part of the larger Penrith Panthers complex. The site proposed for development, the Panther North Precinct is irregular in shape, measuring approximately 280m in the east-west dimension and 240m in the north-south dimension. The site is bounded to west by a lake which we understand is man-made, to the west by Mulgoa Road, to the south by existing car parks and to the north by an electrical power supply corridor and drainage channel.

Gradients in the site are generally flat, rising locally to an elevated platform in the north-west quadrant and near the boundary with the man-made lake.

**Figure 2.1 Site Locality**  
(Excerpted from <https://maps.six.nsw.gov.au>)



**Figure 2.2 – Lot and DP Boundaries**  
(Excerpted from <https://maps.six.nsw.gov.au>)





### 3. GEOTECHNICAL INVESTIGATION

Fieldwork was undertaken between the 10<sup>th</sup> and 24<sup>th</sup> February 2016 and included drilling sixteen (16) boreholes using Ground Technologies 4WD Toyota Landcruiser Solid Flight Auger Drill Rig, and ten (10) boreholes using a track mounted Hanjin D&B drilling rig. Standard Penetration Testing (SPT) was undertaken within selected boreholes and three groundwater monitoring wells were installed. Borehole locations are shown on Figure 1 in Appendix A. Full borehole logs are supplied within Appendix B.

#### 3.1 Subsurface Profiles

A number of distinct geological units were encountered during the field investigation. A generalised description and summary of encountered depths is provided in Tables 2 and 3.

**Table 2: Generalised Summary of Geological Units**

UNIT	SOIL TYPE
Unit A	TOPSOIL; Silty CLAY, medium plasticity, dark brown, moist, with some organic content.
Unit B	ASPHALTIC CONCRETE underlain by road base gravel or sand fill
Unit C	FILL; Admixed Silty SAND / Sandy SILT, fine grained, yellow-brown, brown, with gravel.
Unit D	FILL; Admixed Silty CLAY and Sandy SILT, medium plasticity, brown, red-brown.
Unit E	FILL; Admixed Silty CLAY, medium plasticity, brown, red-brown.
Unit F	NATURAL; Sandy SILT / Silty SAND, SILT with sand, very fine grained, low plasticity, red-brown, red, brown, stiff to very stiff, medium dense to dense, generally loose below about 5m depth.
Unit G	NATURAL; Silty CLAY, medium plasticity, yellow-brown, brown, pale yellow, pale grey, with sand, stiff.
Unit H	NATURAL; Clayey SILT, low plasticity, red and grey, with sand, stiff.
Unit I	NATURAL; Sandy CLAY, medium plasticity, pale grey, brown-yellow, yellow, with silt, Stiff.
Unit J	NATURAL; Clayey SAND, fine grained, pale grey, medium dense to dense.
Unit K	NATURAL; SAND / Silty SAND fine grained, pale brown, loose to medium dense.
Unit L	GRAVEL, medium grained to cobble sized, sub-rounded. Larger clasts up to boulder sized are inferred from drilling resistance and local experience.

No compaction certificates pertaining to the fill material were available at the time of preparing this report. As such, the fill is defined as “**UNCONTROLLED**”

**Table 3: Depth of each Geological Unit**

UNIT	BOREHOLE INTERCEPT DEPTHS (m)									
	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9	BH10
Unit A	-	-	-	0.0-0.1	0.0-0.1	0.0-0.1	-	-	0.0-0.1	-
Unit B	0.0-0.1	0.0-0.1	0.0-0.2		-	-	0.0-0.1	0.0-0.1	-	0.1-0.1
Unit C	0.1-1.5	-	-	0.1-0.4	-	-	-	-	-	-
Unit D	-	-	-	-	-	-	0.1-1.0	-	0.1-1.0	
Unit E	-	-	-	-	-	-	-	0.1-0.5	-	-
Unit F	1.5-3.4	0.1-2.86	0.2-2.0	3.5-4.6	0.1-2.5	0.1-2.0	1.0-5.8	0.5-4.5	1.0-1.8 5.0-5.9	0.1-2.8
Unit G	-	-	-	0.4-2.0	-	-	-	-	2.5-5.0	2.8-4.5
Unit H	-	-	-	2.0-3.5	-	-	-	-	1.8-2.5	-
Unit I	-	-	-	-	-	-	-	-	-	-
Unit J	-	-	-	-	-	-	5.8-6.0	-	-	-
Unit K	-	-	-	-	-	-	-	-	-	4.5-5.0
Unit L	3.4+	2.86+	2+	4.6+	2.5+	2+	6.0-6.2	4.5-4.6	5.9-6.0	5.0-5.1

**Table 3: Depth of each Geological Unit (continued)**

UNIT	BOREHOLE INTERCEPT DEPTHS (m)									
	BH11	BH12	BH13	BH14	BH16	BH17	BH18	BH19	BH20	BH21
Unit A	-	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1
Unit B	0.0-0.1	-	-	-	-	-	-	-	-	-
Unit C	-	0.1-1.0	-	-	-	-	-	-	-	-
Unit D	0.1-0.6	-	-	-	-	-	-	-	-	-
Unit E	-	-	0.1-0.5	0.1-2.0	0.1-1.0	0.1-2.0	0.1-1.5	0.1-3.0	0.1-1.7	0.1-2.0
Unit F	0.6-1.0	1.0-4.5	0.5-2.6	2.0-2.7 3.1-3.8 4.3-4.6	1.0-1.7 5.0-6.1	2.0-4.5 6.0-9.4	1.5-8.5	3.0-4.0	1.7-2.0 3.0-8.6	-
Unit G	-	-	-	2.7-3.1 3.8-4.3	1.7-3.2	-	-	-	2.0-3.0 8.6-9.0	2.0-5.7
Unit H	-	-	-	-	-	-	-	-	-	-
Unit I	-	-	-	4.6-5.5	3.2-5.0	4.5-6.0	-	-	-	-
Unit J	-	-	-	5.5-7.0	-	-	-	4.0-6.0	-	-
Unit K	-	-	2.6-3.5	-	-	-	8.5-9.5		9.0-10.6	5.7 - 9.0
Unit L	1.0+	4.5+	3.5-3.7+	-	-	9.4+	9.5+	6.0+	10.6-11.5+	9.0-10.5+

**Table 3: Depth of each Geological Unit (continued)**

UNIT	BOREHOLE INTERCEPT DEPTHS (m)						
	BH22	BH23	BH24	BH25	BH26	BH27	BH28
Unit A	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1
Unit B	-	-	-	-	-	-	-
Unit C	-	-	-	-	-	-	-
Unit D	-	-	-	-	-	-	0.1-0.4
Unit E	0.1-1.6	0.1-2.0	0.1-1.8	0.1-2.0	0.1-2.2	0.1-2.8	0.4-1.5
Unit F	2.8-4.5 6.5-9.2	-	4.5-9.0	2.0-6.5	4.1-7.2	2.8-4.1 6.5-10.5	1.5-8.6
Unit G	2.4-2.8	2.0-5.0	1.8-3.0	-	-	4.0-6.5	-
Unit H	1.6 - 2.4	-	3.0-4.5	-	-	-	-
Unit I	4.5-6.5	-	-	-	2.2-4.1	-	-
Unit J	-	-	-	-	7.2-7.5	-	-
Unit K	-	5.0-9.0	-	6.5-9.7	-	-	-
Unit L	9.2+	9.0-10.0+	9.0+	9.7-10.0+	-	10.5+	8.6+

The subsurface geotechnical model for the site is comprised of the following:

- Topsoil or Asphaltic concrete surfacing, underlain by fill with depths ranging from 0.1m to a maximum of 3.0m over the whole of the site.
- The eastern part of the site, comprising the car parks areas and vacant house generally have shallower depths of fill, ranging from 0.1m (natural soil below topsoil) to a maximum of 1.5m depth.
- The western and north-western parts of the site, including the area adjacent to the lake appear to be on a fill platform. Fill was logged in all boreholes in this area, from surface to depths ranging from 1.0m to 3.0m.
- The natural soil profile was stiff to very stiff (clay) and medium dense (sand) above the groundwater level. These soils decreased in strength to be soft to stiff (clay) and loose to medium dense (sand) below the groundwater level.
- Several boreholes were observed to collapse within the sand profile below ground water levels.
- All boreholes that encountered the dense gravel (Unit L) were met with rig refusal within 1.0m of the top of this unit. Excavations in the region have encountered this profile and indicate the material to comprise rounded gravels up to 300mm in size with sand infill material.



Given the potential for soft and saturated soils to be encountered within the natural sands and clays, it is anticipated that all significant loads from the super structure will be passed to the dense gravel (Unit L) as a founding stratum. The depth to this material is detailed in table 4 and levels in Figure 2 in Appendix A.

**Table 4: Summary of Dense Gravel (Unit L) Depths**

Borehole	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9
Depth to Gravel <sup>1</sup>	3.4m	2.8m	2.0m	4.6m	2.5m	2.0m	6.0m	4.5m	5.9m
R/L of Gravel <sup>2</sup>	23.6m	24.1m	25.1m	22.2m	24.4m	24.5m	20.3m	21.4m	19.4m

**Table 4a: Summary of Dense Gravel (Unit L) Depths**

Borehole	BH10	BH11	BH12	BH13	BH14	BH16	BH17	BH18	BH19
Depth to Gravel <sup>1</sup>	5.0m	1.0m+	4.5m	3.5m	7.0m+	6.1m+	9.4m	9.5m	8.5m
R/L of Gravel <sup>2</sup>	20.5m	-	20.5m	22.0m	-	-	16.6m	16.0m	17.0

**Table 4b: Summary of Dense Gravel (Unit L) Depths**

Borehole	BH20	BH21	BH22	BH23	BH24	BH25	BH26	BH27
Depth to Gravel <sup>1</sup>	10.6	9.5m	9.2m	9.0m	9.0m	9.7m	7.5m+	10.5m
R/L of Gravel <sup>2</sup>	16.4m	17.0m	17.3m	17.5m	15.0m	15.8m	-	15.8m

Note 1 – Depth is below ground surface levels at the time of field work

Note 2 - R/L is approximated from supplied site plan prepared by Freeburn Surveying, ref.14443, sheet 1 of 1

### 3.2 Groundwater

Groundwater was observed in only one borehole (BH9) on the eastern part of the site and in all boreholes in the western and north-western part of the site, at depths ranging from 5.0 to 6.5m below existing ground surface levels. The depth of Groundwater is detailed in table 5 and levels in Figure 3 in Appendix A.

**Table 5: Summary of Groundwater Depths**

Borehole	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9
Depth of GW <sup>1</sup>	-	-	-	-	-	-	-	-	5.0m
R/L of GW <sup>2</sup>	-	-	-	-	-	-	-	-	25.25

**Table 5a: Summary of Groundwater Depths**

Borehole	BH10	BH11	BH12	BH13	BH14	BH16	BH17	BH18	BH19
Depth of GW <sup>1</sup>	-	-	-	-	6.5m	6.0m	6.0m	6.5m	6.0m
R/L of GW <sup>2</sup>	-	-	-	-	19.5m	19.5m	20.0m	19.0m	19.5m

**Table 5b: Summary of Groundwater Depths**

Borehole	BH20	BH21	BH22	BH23	BH24	BH25	BH26	BH27
Depth of GW <sup>1</sup>	6.5m	6.5m	6.5m	6.0m	5.0m	5.0m	5.5m	5.0m
R/L of GW <sup>2</sup>	20.0m	20.0m	20.0m	20.5m	19.0m	20.5m	21.0m	19.5m

Note 1 – Depth is below ground surface levels at the time of field work

Note 2 - R/L is approximated from supplied site plan prepared by Freeburn Surveying, ref.14443, sheet 1 of 1

It is inferred that the adjoining aqua lake has been designed with an appropriate capping layer as no seepage was observed in the upper soil profiles and groundwater levels observed are significantly lower than the water level

within the lake.

### 3.3 Laboratory Test Results for Soil Properties

Five (5) soil samples were recovered for soil material parameter testing during the course of the field investigation. These samples were submitted to Ground Technologies NATA accredited laboratory in order to determine the California Bearing Ratio, Shrink / Swell Index, Plastic limits and Emerson class of the underlying soil profile. The results are summarized in table 5 below whilst the full reports are contained within Appendix C.

**Table 6: Summary of Laboratory Test Results for Soil Properties**

Sample ID	Borehole	Unit	Soil Profile	Depth	CBR
L1	BH5	F	Silty Sand	0.1-1.0m	17%
L2	BH16	E	Silty Clay (fill)	0.1-1.0m	9%
L3	BH22	E	Silty Clay (fill)	0.1-1.0m	3.5%

**Table 7: Summary of Laboratory Test Results for Particle Size Distribution (PSD)**

Sample ID	Borehole	Depth	Gravel	Sand	Silt	Clay
L4	BH4	2.0-3.0m	0%	52%	18%	30%
L5	BH16	1.3-2.0m	0%	43%	21%	36%
L6	BH16	2.2-3.2m	0%	27%	33%	40%

The laboratory test results show that the material composition and geotechnical properties are highly variable across the site. For design purposes, conservative values will be apportioned.

## 4. GEOTECHNICAL DESIGN RECOMMENDATIONS

### 4.1 Site Classification For Light Residential and Commercial Structures

This site is classified as Class P in accordance with AS2870 – 2011, owing to the following factors:

- Clause 2.5.3 (b) (ii): Uncontrolled fill greater than 0.4m depth comprising a material other than sand.

### 4.2 Footings – Allowable End Bearing Capacity

The fill encountered on site and deep alluvial soils are considered unsuitable for placement of high level foundations for multistorey structures. As such, we recommend that all significant structures within the proposed development be supported on an engineered designed **fully suspended footing system**.

We recommend piled structures be founded on the dense gravel layer denoted as Unit L, detailed in Section 3.1 and table 4 of this report. As the natural gravel is a cohesionless material, the depth of overburden material exerting a surcharge on the foundation material will impact the end bearing capacity of the pile, as will the depth of groundwater. The design of foundation systems shall be proportioned using a maximum allowable bearing pressure in accordance with Table 8. It is advised based on local experience that it would not be practicable to socket piles greater than 1m depth into the dense gravel layer, as the larger gravels will jam the augers of drill rigs.

**Table 8: Design Parameters for Bored Piers Constructed Below the Ground Water Table**

Depth Below Bulk Excavation Levels	Allowable End Bearing Capacity
2m	450kPa
3m	560kPa
4m	680kPa
5m	800kPa
6m	920kPa
7m	1000kPa

**Table 9: Design Parameters for Bored Piers Constructed Above the Ground Water Table**

Depth Below Bulk Excavation Levels	Allowable End Bearing Capacity
2m	610kPa
3m	730kPa
4m	840kPa
5m	960kPa

Where groundwater is anticipated, we recommend the use of CFA piles or casing for bored piles, as the insitu soils are prone to collapse when saturated. As such, skin friction will be neglected in these locations. A nominal skin friction of 10kPa may be applied to natural materials above groundwater (when casing is not utilized).

For lightly loaded structures, articulated from the main structures, an allowable end bearing capacity of 100kPa can be applied to all natural soils that are located at least 1.5m above the ground water level.

All footing excavations should be free of loose debris and wet soil prior to concrete placement. Should groundwater enter footing excavation, all water should be pumped from the base of the footing excavations prior to concrete placement. Concrete placement should proceed as soon as practicable after footing excavation to prevent impending reduction of allowable end bearing pressures as a result of exposure.

### 4.3 Batter Slopes

Slopes may be battered at gradients provided in Table 10 below, in the absence of surcharge loading.

**Table 10: Maximum Gradients for Batters**

Material	Maximum Batter Gradient (V : H)	
	Permanent	Temporary
Natural SILT, SAND or CLAY dominant site soils.	1 : 2 (26°)	1 : 1 (45°)

Should there be an insufficient space for batter construction, excavations should be retained prior to excavation.

### 4.4 Excavation Conditions & Vibration Control

Excavation within the site filling and alluvial soils could be achieved with a bucket attachment to a mid sized excavator. As no excavation in bedrock is anticipated for the proposed development, vibration monitoring is not expected to be required.

The excavations are anticipated to be through site filling and natural soils predominantly comprising very fine grained Sand and Silt alluvium. The natural fine grained soils are expected to rapidly loose strength when exposed to water. As such, trafficability issues may arise during periods of rainfall. It may be prudent to place a 300mm lift of road base / gravel on basement level excavations to improve trafficability after rainfall events.

### 4.5 Temporary Shoring & Retaining Walls

It is anticipated that permanent batter slopes are not proposed for the development, and temporary batter slopes limited where they are precluded by site conditions and geometry; therefore temporary shoring would be required.

The following shoring systems could be considered for this site:

1. Conventional shoring using soldier piles, steel walers and shotcrete infill panels.
2. Secant or contiguous piles
3. Steel sheet piles
4. Cement Slurry Mix (CSM)
5. Diaphragm Wall

Retaining walls may be designed as braced retaining walls, where they will have permanent lateral restraint provided by basement and lower level floor slabs.

Temporary excavation support should be designed as a cantilever retaining wall.

#### 4.6 Retaining Walls Design Parameters

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure co-efficient is recommended. If it is critical to limit the horizontal deformation of a retaining structure, use of an earth pressure co-efficient at rest should be considered. Recommended parameters for the design of retaining structures are presented in table 11.

**Table 11: Retaining Wall Design Parameters for each Geological Unit**

Geotechnical Property	Geological Unit	
	Unit A to K	Unit L
	Natural and Fill Silts, Sands, Clays	Dense Gravel
Friction angle	26°	45°
Ka	0.4	0.2
Ko	0.6	0.3
Kp	2.6	5.8
Unit Weight (kg/m <sup>3</sup> )	19	21

Surcharge loads (if applicable) will ADD to the earth pressure acting on retaining walls. In the case of non rigid walls, assume  $K_a$  x surcharge load will be converted to lateral thrust. For rigid walls assume  $K_o$  x surcharge load will be converted to loaded thrust. Allowance should be made for sloping backfill (if applicable).

Walls should be constructed as soon as possible after cutting operations. Subsurface drains should be provided in any backfill material, discharge from subsurface drains should be to an approved discharge point. It is recommended that a minimum of 300mm width of free draining aggregate is provided as a drainage medium behind the retaining walls

#### 4.7 Pavement Design for Internal Roads

With reference to Penrith Councils "Design Guidelines For Engineering Works For Subdivisions and developments", we understand that the proposed pavements within the development will be local access streets with a design traffic loading to be expected to be in the order of  $5 \times 10^5$  ESA's (Equivalent Standard Axles).

Based on the design traffic loading detailed above, a CBR value of 4.0% for the subgrade materials and in accordance with ARRB-SR41, (Australian Road Research Board, Special Report No. 41 – A Structural. Design Guide for Flexible Residential Street Pavements, 1989 – Table 7) we recommend the following design pavement thicknesses for the proposed pavement.

**Table 12: Pavement Design Thickness – Flexible Pavement**

Pavement Materials	5 x 10 <sup>5</sup> ESA's
Asphaltic Concrete Wearing Surface (AC10)	50
Base Course (DGB 20)	150
Sub-base Course (Crushed Sandstone or DGS40)	300
<b>Total:</b>	<b>500mm</b>

A deep fill profile was encountered within the alignment of the pavements. No compaction certificates were provided for the filling and considering the age of the pavement, they are unlikely to be made available. As such the fill is defined as "Uncontrolled". Prior to the commencement of the pavement construction it is recommended that this fill be remediated to provide a suitable foundation for the proposed new pavement. The subgrade remediation should be undertaken in accordance with good engineering principles and the following recommendations.

- Strip existing fill to a depth to reveal the natural soil profile or to a maximum depth of 1000mm below design subgrade level. The stripped materials may be stockpiled for re-use as controlled fill.
- Compact exposed (subgrade) natural surfaces with a minimum of 7 passes of an 8 to 10 tonne static weight smooth drum roller, then proof roll the compacted subgrade to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of 300mm and replace with suitable fill. The proof rolling should be supervised by a suitably qualified Geotechnical Engineer / Engineering Geologist.
- On certification of proof rolling, placement of the replacement subgrade materials may proceed. The material should be placed in a maximum compacted layer of 300mm and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, with a moisture content within 2% of Optimum Moisture Content (OMC). The replacement subgrade will require compaction testing of both layers in order to confirm the required density values have been attained.

Once the subgrade has been remediated, the proposed pavement should be constructed in accordance with good engineering principles and the following recommendations.

- Compact exposed (subgrade) natural surfaces with a minimum of 7 passes of an 8 to 10 tonne static weight smooth drum roller, then proof roll the compacted subgrade to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of 300mm and replace with suitable fill
- The proof rolling should be supervised by a suitably qualified Geotechnical Engineer / Engineering Geologist.
- On certification of proof rolling, placement of the pavement materials may proceed. The following minimum dry density ratios (AS1289 5.4.1 - 1993) must be achieved during pavement construction.
  - Base Course 98% Modified
  - Sub-base 95% Modified
  - Sub-grade top layer 100% Standard
- The new pavements will require compaction testing at subgrade, sub-base and base course levels in order to confirm the required density values have been attained.
- Quality Assurance testing of materials and earthworks should be undertaken in accordance with Sections 5.1.2 and 5.1.3 of Penrith City Council Page Engineering Construction Specification for Civil Works



## **5. CONDITIONS OF THE RECOMMENDATIONS**

The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the building site may differ from those found in the test holes. If excavations reveal subsurface conditions significantly different from those shown in our attached Soil/Rock Log(s), Ground Tech must be consulted and excavations stopped immediately.

The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. The description of the foundation material for has been provided for its easy recognition over the whole building site.

Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building. Dimensions on logs are correct.

## **6. LIMITATIONS**

This type of investigation (as per our commission) is not designed or capable of locating all ground conditions, (which can vary even over short distances). The advice given in this report is based on the assumption that the test results are representative of the overall ground conditions. However, it should be noted that actual conditions in some parts of the site might differ from those found. If further sampling reveals ground conditions significantly different from those shown in our findings, Ground Tech must be consulted.

The scope and the period of Ground Tech services are described in the report and are subject to restrictions and limitations. Ground Tech did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ground Tech in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ground Tech for incomplete or inaccurate data supplied by others.

Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning.

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## APPENDIX A

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### Figures







APPROXIMATE  
LEVELS (RL) OF  
TOP OF GRAVEL  
(UNIT L) ARE  
SHOWN  
ANNOTATED

GROUND  
TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd

ABN 25 089 213 294

PO Box 1121 Green Valley NSW 2168

Ph: (02) 8783 8200

Fax: (02) 8783 8210

Email: lab@groundtech.com.au

DATA SHOWN IS APPROXIMATE & INTENDED  
TO ILLUSTRATE THE R/L OF THE DENSE  
GRAVEL ENCOUNTERED WITHIN THE  
INVESTIGATION.

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N  
W  
E  
S

REV	DATE	COMMENT

PROJECT:	GTE774
TITLE:	GRAVEL UNIT LEVELS
FIGURE No:	2
REV:	A
DATE:	15/2/2015
DRAWN:	JH
CHECKED:	AB

SCALE:	APPROX SCALE, SEE SCALE BAR	PLOT SIZE:	A3
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## **APPENDIX B**

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### **Borehole Logs**



Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 27.0m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L	0.5	-	ASPHALTIC CONCRETE (20mm)	D	-		DS BH1-A	PAVEMENT FILL
			Silty SAND, fine grained, yellow-brown, brown, with gravel					
	1							
	1.5	ML	Sandy SILT, low plasticity, red-brown, with clay	SM <Wp	St			ALLUVIUM
	2							
	2.5							
	3							
	3.5		Borehole terminated at 3.4m					Auger refusal on GRAVEL
	4							
	4.5							
	5							
	5.5							
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: Track Mounted Hanjin D&amp;B

Surface RL: 27.0m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	ASPHALTIC CONCRETE (50mm) and Sand fill.	-	-			PAVEMENT
		ML	Sandy SILT / SILT with sand, low plasticity, dark red-brown	VSM <<Wp	St/ VSt			ALLUVIUM
	0.5						DS BH2-A	
	1		As above, becoming Sandy SILT, red-brown.	SM				SPT 1.0-1.45m, N=12
	1.5							
	2							
	2.5	SM	Silty SAND, very fine grained, red.	D	MD			SPT 2.4-2.86m, N=R
	3		Borehole terminated at 2.86m					SPT refusal on GRAVEL.
	3.5							
	4							
	4.5							
	5							
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 27.0m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L	0.5	-	ASPHALTIC CONCRETE (20mm)	D	-			PAVEMENT
			Silty SAND, fine grained, yellow-brown, brown, with gravel				BH3-A	FILL
		ML	Sandy SILT, low plasticity, red-brown, with clay	SM <Wp	St		DS BH3-B	ALLUVIUM
	1							
	1.5							
	2							
	2.5		Borehole terminated at 2.0m					Auger refusal on GRAVEL
	3							
	3.5							
	4							
	4.5							
	5							
	5.5							
	6							

### Explanatory Notes

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.75m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
			Silty CLAY, medium plasticity, yellow-brown, with sand.	SM	St		DS BH4-A	FILL
	0.5	CL-CH	Silty CLAY, medium plasticity, yellow-brown, with sand.				DS BH4-B	ALLUVIUM
	1							pp. 140 kPa
	1.5							
	2	ML	Clayey SAND, low plasticity, red and grey, with silt.		MD			
	2.5						DS L4	
	3							
	3.5		Silty SAND, fine grained, red.					
	4		As above, pale grey.					
	4.5							
	5		Borehole terminated at 4.6m					Auger refusal on GRAVEL.
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 27.0m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
		SM	Silty SAND, fine grained, red-brown, brown.		VL-L		DS BH5-A & L1	ALLUVIUM
	0.5							
	1			SM				SPT 1-1.45m, N=4
	1.5		As above, with clay.					
	2							
	2.5	GP	As above, pale brown. GRAVEL, medium grained to boulder sized, sub-rounded.					SPT 2.5-2.53m, N=R SPT Bouncing
			Borehole terminated at 2.53m					SPT refusal on GRAVEL
	3							
	3.5							
	4							
	4.5							
	5							
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: Track Mounted Hanjin D&B

Surface RL: 26.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
		ML	Sandy SILT, low plasticity, red.	SM	St			ALLUVIUM
	0.5		SILT, low plasticity, trace of fine sand and clay.					
	1							
	1.5							
	2		Borehole terminated at 2.0m					Auger refusal on GRAVEL.
	2.5							
	3							
	3.5							
	4							
	4.5							
	5							
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl



Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.25m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	ASPHALTIC CONCRETE (50mm) and Roadbase Gravel.	Dry <Wp	-			PAVEMENT FILL Appears compacted.
	0.5		Adixed Silty CLAY and Sandy SILT, medium plasticity, brown, red-brown.				DS BH7-A	
	1	ML	Sandy SILT / Silty SAND, very fine grained, brown, yellow-brown.		MD-D		DS BH7-B	ALLUVIUM
	1.5							
	2							
	2.5							
	3							
	3.5							
	4		SILT, low plasticity, pale grey, with some to trace of fine sand.		VD			Medium drilling resistance typical for weathered bedrock.
	4.5							
	5		Interbedded SILT with sand, Clayey SAND and Silty CLAY, pale grey and yellow-brown.					
	5.5							
	6	SC	Clayey SAND, fine grained, pale grey		MD-D			
		GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			

**Explanatory Notes**

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Project: No.: GTE774

Date of Drilling:

17/02/2016

Location: Mulgoa Road, Penrith

Logged by:


JH/SM

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.25m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
		GP	GRAVEL, medium grained to boulder sized, sub-rounded.		D			
			Borehole terminated at 6.2m					Auger refusal on GRAVEL.
	6.5							
	7							
	7.5							
	8							
	8.5							
	9							
	9.5							
	10							
	10.5							
	11							
	11.5							
	12							

### Explanatory Notes

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 26.0m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	ASPHALTIC CONCRETE (50mm) and Road base	D	-			PAVEMENT
			Admixed Silty Clay, medium plasticity, brown, red-brown.	<<Wp			DS BH8-A	FILL
	0.5	ML	Sandy SILT, low plasticity, red-brown.		H			ALLUVIUM
	1						DS BH8-B	
	1.5							
	2							
	2.5							SPT 2.5-2.95m, N=32
	3							
	3.5							
	4		As above, pale grey.		VSt			SPT 4.0-4.45m, N=29
	4.5	GP	GRAVEL, medium grained to boulder sized, sub-rounded.	D				
			Borehole terminated at 4.6m					Auger refusal on GRAVEL.
	5							
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 25.25m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	ASPHALTIC CONCRETE (50mm) and Sand fill Adixed Silty CLAY and Sandy SILT, medium plasticity, red.	Dry <Wp	-		DS BH9-A	PAVEMENT FILL Appears compacted.
	1	ML	SILT, low plasticity, grey, dark grey, with fine sand.		St			ALLUVIUM
	1.5						DS BH9-B	
	2		Clayey SILT, low plasticity, brown-yellow.	D-SM <Wp				
	2.5	CL	Silty CLAY, low to medium plasticity, brown, red, grey.		VSt			pp. 400 kPa
	3							
	3.5							
	4		As above, becoming more pale grey.					pp. 250 kPa
	4.5							
	5	SM	Silty SAND, very fine grained, pale grey, with clay.	Wet	MD			
	5.5							
	6	GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			
			Borehole terminated at 6.0m					Auger refusal on GRAVEL

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 25.5m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	ASPHALTIC CONCRETE (50mm) and Sand fill	Dry	-			PAVEMENT
		ML/ SM	Silty SAND / Sandy SILT, very fine grained, red, with clay.	<Wp	MD			ALLUVIUM
	0.5						BH10-A	
	1		Sandy SILT, low plasticity, brown-yellow.		St			
	1.5							
	2							
	2.5							
	3	CL-CH	Silty CLAY, low to medium plasticity, red, brown, grey, with fine interbeds of Clayey SILT and SAND.	SM	VSt			pp. 250 kPa
	3.5							
	4							
	4.5	ML	Silty SAND, very fine grained, pale grey, with clay.					
	5	GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			
			Borehole terminated at 5.1m					Auger refusal on GRAVEL
	5.5							
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 25.0m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L	0.5	-	ASPHALTIC CONCRETE (50mm) and Sand fill	Dry <Wp	-			PAVEMENT FILL
			Admixed Silty CLAY and SILT, medium plasticity, brown.					
		SW/ ML	Silty SAND / Sandy SILT, very fine grained, yellow-brown, dark brown		St			ALLUVIUM
	1		Borehole terminated at 1.0m					Auger refusal on GRAVEL.
	1.5							
	2							
	2.5							
	3							
	3.5							
	4							
	4.5							
	5							
	5.5							
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl



Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 25.75m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L	0.5	-	Sandy SILT, brown, with clay and organic content.	Dry	-		DS BH12-A	TOPSOIL FILL Appears compacted.
			Gravelly SAND, medium grained, grey, fine gravel.					
			Admixed Sandy SILT, brown, red-brown.					
	1	ML	SILT, low plasticity, red, with very fine sand.		St		DS BH12-B	ALLUVIUM
	1.5							
	2							
	2.5		becoming orange-brown.					
	3							
	3.5	SM	Silty SAND, fine grained, red.		MD			
	4							
	4.5		Borehole terminated at 4.5m					Auger refusal on GRAVEL
	5							
	5.5							
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N I L		-	Sandy SILT, brown, with clay and organic content.	Dry	-		DS BH13-A	TOPSOIL FILL
			Admixed Silty Clay, medium to high plasticity, brown, red-brown.					
	0.5	ML	Sandy SILT, low plasticity, red, red-brown.					ALLUVIUM
	1							SPT 1.0-1.45m, N=15
	1.5							
	2							
	2.5	SP	SAND, fine grained, pale brown.		MD			
	3							
	3.5	GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			
	4		Borehole terminated at 3.7m					Auger refusal on GRAVEL.
	4.5							
	5							
	5.5							
	6							

### Explanatory Notes

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.0m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
	1		Admixed Silty Clay, medium to high plasticity, brown, red-brown.	<Wp			DS BH14-A	FILL Appears compacted.
	1.5						DS BH14-B	
	2	SM	Sandy SILT, low plasticity, red, red-brown, with clay.		VSt-H			
	2.5							
	3	CL-CH	Silty CLAY, medium plasticity, brown, dark-brown, with fine sand.					
	3.5	SM	Silty SAND, very fine to fine grained, yellow-brown, grey-brown.					
	4	CL-CH	Silty CLAY, medium plasticity, brown, dark-brown, with fine sand.	SM =Wp	St-VSt			pp. 150 kPa
	4.5	SM	Silty SAND, very fine grained, grey, with interbeds of clay.					
	5	CL-CH	Sandy CLAY, medium plasticity, pale grey and yellow, with silt.					pp. 80 - 100 kPa
	5.5	SC	Clayey SAND, very fine grained, pale grey, with silt.					
	6	SC/CL		M	F-St			

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H


Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.0m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5	SC/CL	Interbedded Sandy CLAY and Silty CLAY, medium plasticity, brown, red-brown, yellow-brown, grey.	M >Wp	F-St			pp. 100 kPa
	7		Borehole terminated at 7.0m					
	7.5							
	8							
	8.5							
	9							
	9.5							
	10							
	10.5							
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 25.5m

Sheet 1 of 1

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
		-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
	0.5		Admixed Silty Clay, medium to high plasticity, brown, red-brown.	<Wp			DS BH16-A & L2	FILL
	1	ML	Clayey SAND, very fine grained, red, red-brown, with silt.		MD		DS BH16-B	ALLUVIUM
	1.5						DS BH16-C & L5	
	2	CL	Silty CLAY, medium plasticity, brown, grey-brown.	SM =Wp	H			
	2.5		Sandy Silty CLAY, medium plasticity, yellow-brown with grey.					pp. 400 kPa
	3						DS L6	
	3.5		As above, yellow-brown and pale grey.					
	4		Becoming more clayey.					pp. 200 - 250 kPa
	4.5							
	5	SM	Silty SAND, very fine to fine grained, yellow-brown, grey-brown.	M				
	5.5							
	6		Borehole terminated at 6.1m	W				

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.0m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content. Admixed Silty Clay, medium plasticity, brown, pale-yellow red-brown.	D D-SM <Wp	-		DS BH17-A	TOPSOIL FILL Appears compacted.
	1							
	1.5							
	2	ML	Sandy SILT, low plasticity, red, red-brown.	SM <Wp	St		DS BH17-B	ALLUVIUM
	2.5							
	3		As above, becoming brown, yellow-brown.		VSt - H			
	3.5							
	4							
	4.5	CL	Sandy CLAY, medium plasticity, yellow-brown, pale grey.		St			
	5							
	5.5							
	6	SM	Silty SAND, very fine to fine grained, yellow-brown, brown.	W	L			

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.0m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5 7 7.5 8 8.5 9	SM	Silty SAND, very fine to fine grained, yellow-brown, brown. (contd.)	W	L			
	9.5 10 10.5 11 11.5 12		Borehole terminated at 9.4m					Auger refusal on GRAVEL.

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content. Admixed Silty Clay, medium to high plasticity, brown, red-brown.	D	-		DS BH18-A	TOPSOIL FILL Appears compacted.
	1		Admixed Silty Clay, medium to high plasticity, brown.				DS BH18-B	
	1.5	ML	Sandy SILT, red-brown / yellow-brown, trace of clay, with occasional interbeds of Clayey SILT, low plasticity, pale grey.		St/MD		DS BH18-C	ALLUVIUM
	2							
	2.5							SPT 2.5-2.95m, N=19
	3							
	3.5							
	4							SPT 4.0-4.45m, N=16 pp. 100 kPa
	4.5	SM	Silty SAND, very fine grained, red-brown / yellow-brown.	M	MD			
	5							
	5.5			W				SPT 5.5-5.95m, N=12
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl




Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
X	6.5		SAND, very fine to fine grained, red-brown / yellow-brown, with silt.	W	L			SPT 7.0-7.45m, N=7
	7							
	7.5							
	8							
	8.5	SP	SAND, fine to medium grained, angular to sub-angular, pale grey and yellow-brown, with silt.		MD			SPT 8.5-8.95m, N=13
	9							
	9.5		Borehole terminated at 9.5m					Auger refusal on GRAVEL.
	10							
	10.5							
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
	1		Admixed Silty Clay, medium to high plasticity, brown, red-brown.	<Wp			DS BH19-A	FILL Appears compacted.
	1.5						DS BH19-B	
	2						DS BH19-C	
	2.5							SPT 2.5-2.95m, N=31
	3	ML	Sandy SILT, brown, pale grey.	SM	St/MD			ALLUVIUM
	3.5						DS BH19-D	
	4	SC	Clayey SAND, very fine grained, brown, pale grey.		MD			SPT 4.0-4.45m, N=18
	4.5							
	5							
	5.5		Becoming brown, yellow-brown and pale grey.		L/MD			SPT 5.5-5.95m, N=10
	6			W				

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5			W	L-MD			
	7							Could not conduct SPT due to collapse of saturated sand.
	7.5							
	8							
	8.5							SPT 8.5-8.6m, N=R
			Borehole terminated at 8.6m					SPT refusal on gravel.
	9							
	9.5							
	10							
	10.5							
	11							
	11.5							
	12							

### Explanatory Notes

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&amp;B

Surface RL: 26.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	D	-			TOPSOIL
	1		Admixed Silty Clay, medium to high plasticity, brown, red-brown.	<Wp			DS BH20-A	FILL Appears compacted.
	1.5						DS BH20-B	SPT 1.0-1.45m: N=12 pp. 600+ kPa
	2	ML/SM	Sandy SILT / Silty SAND, very fine grained, yellow-brown, with clay.		MD			ALLUVIUM
	2.5	CL-CH	Silty CLAY, medium plasticity, dark grey to grey with yellow-brown, with clay.				DS BH20-C	SPT 2.5-2.95m: N=24 pp. 600+ kPa
	3							
	3.5	ML/SM	Sandy SILT, low plasticity, red-brown / yellow-brown, trace of clay.					
	4						SPT BH20-D	SPT 4.0-4.45m: N=22 pp. 350 kPa
	4.5							
	5		Silty SAND, very fine grained, orange, yellow-brown and pale grey,					
	5.5			SM - M				SPT 5.5-5.95m: N=20
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H



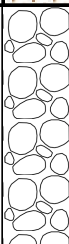
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 26.5m

Sheet 2 of 2

Co-ords: -

Sheet 2 of 2		CS-013.						
WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N	6.5	ML/ SM	Silty SAND, very fine grained, orange, yellow-brown and pale grey,					
				W	L			
	7							
	7.5							
	8	SP	SAND, fine to medium grained, angular to sub-angular, pale grey and yellow-brown, with silt.					SPT 7.0-7.45m, N=8 pp. 50kPa
	8.5	CL	Silty CLAY / Clayey SILT, low plasticity, pale grey and yellow-brown.	VM >>Wp	St			
	9	SP	SAND, fine to medium grained, angular to sub-angular, pale grey and yellow-brown, with silt.	W	L			
	9.5							
	10							
	10.5							
11	GP	GRAVEL, medium grained to boulder sized, sub-rounded.		D		SPT 8.5-8.95, N=15 pp. 150 kPa		
11.5	Borehole terminated at 11.5m							Auger refusal on cobbles.
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: Track Mounted Hanjin D&B

Surface RL: 26.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	D	-			TOPSOIL
	1		Admixed Silty Clay, medium to high plasticity, brown, red-brown.	<Wp			DS BH21-A	FILL Appears compacted.
	1.5						DS BH21-B	
	2	CL-CH	Silty CLAY, medium plasticity, grey, dark grey	SM <Wp	St			ALLUVIUM
	2.5						DS BH21-C	SPT 2.5-5.95m, N=9 pp. 200 kPa
	3							
	3.5							
	4							SPT 4.0-4.45m, N=13 pp. 250 - 350 kPa
	4.5							
	5							
	5.5							SPT 5.5-5.95m, N=19
	6	SM	Silty SAND, very fine grained, pale brown, pale grey.	SM	MD			

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H


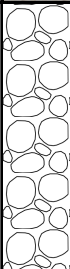
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: Track Mounted Hanjin D&B

Surface RL: 26.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
N	6.5	SM	Silty SAND, very fine grained, pale brown, pale grey (contd.)	SM	MD			
			As above, becoming more sandy.	W	L-MD			
	7							SPT 7.0-7.45m, N=10
	7.5							
	8							
	8.5							
	9							
	9.5	GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			
	10							
	10.5		Borehole terminated at 10.5m					Auger refusal on GRAVEL
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content. Admixed Silty Clay, medium plasticity, brown, yellow-brown. As above, brown, grey-brown, pale yellow.	D SM	-		DS BH22-A & L3	TOPSOIL FILL Appears compacted.
	1							
	1.5							
	2	ML	Clayey SILT, low plasticity, dark brown, pale grey.	M >Wp	F		DS BH22-B	ALLUVIUM
	2.5	CL	Silty CLAY, medium plasticity, brown, red-brown.	SM <Wp	St			pp. 200 kPa
	3	ML	Sandy SILT, low plasticity, brown, yellow-brown.					
	3.5							
	4							
	4.5	CL	Sandy CLAY, medium plasticity, yellow-brown, pale grey.					
	5							
	5.5							
	6							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl





Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
X	6.5	SM	Sandy CLAY, medium plasticity, yellow-brown, pale grey. (contd.)	SM <Wp	St			
	7		Silty SAND, very fine to fine grained, yellow-brown, brown.	W	L			
	7.5							
	8							
	8.5							
	9							
	9.5		Borehole terminated at 9.2m					Auger refusal on GRAVEL
	10							
	10.5							
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 26.25m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
		-	Sandy SILT, brown, with clay and organic content.	D	-			TOPSOIL FILL
	0.5		Admixed Silty Clay, medium plasticity, brown, red-brown.	SM			DS BH23-A	
	1			D				SPT 1.0-1.45m N=17
	1.5						DS BH23-B	
	2		Silty CLAY, low to medium plasticity, grey and yellow-grey.	SM <Wp	St			
	2.5						DS BH23-C	SPT 2.5-2.95m, N=14
	3							
	3.5		As above, orange-brown and pale-brown.					
	4							SPT 4.0-4.45m, N=15 pp. 300 kPa
	4.5							
	5		Silty SAND, very fine grained, interbeds of pale grey and orange-brown.		MD			
	5.5							SPT 5.5-5.95m, N=12
	6			W	L			

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 26.25m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5		Silty SAND, very fine grained, interbeds of pale grey and orange-brown (contd.)	W	L			
	7		As above, becoming more sandy.					
	7.5							
	8							
	8.5							
	9		GRAVEL, medium grained to cobble sized, sub-rounded.		D			
	9.5							
	10		Borehole terminated at 10m					Auger refusal on GRAVEL
	10.5							
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 24.0m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content. Admixed Silty Clay, medium plasticity, brown, red-brown, yellow-brown.	D	-			TOPSOIL FILL Appears compacted.
	1							
	1.5							
	2	CL/ CH	Silty CLAY, medium plasticity, yellow-brown, brown, pale yellow pale grey.	SM	St			pp. 100 kPa
	2.5							
	3	ML	Clayey SILT, low plasticity, yellow-brown.	M >Wp				
	3.5							
	4							
	4.5	SM	Silty SAND, very fine grained to fine grained, brown, yellow-brown.		L			
	5			W				
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 24.0m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5 7 7.5 8 8.5 9	SM	Silty SAND, very fine grained to fine grained, brown, yellow-brown. (contd.)	W	L			
	9 9.5 10 10.5 11 11.5 12		Borehole terminated at 9.0m					Auger refusal on GRAVEL

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&B

Surface RL: 25.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
		-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL FILL
	0.5		Admixed Silty Clay and fine gravel, medium to high plasticity red-brown, brown.				DS BH25-A	
	1		Admixed Silty Clay, medium to high plasticity, brown, red-brown.				DS BH25-B	
	1.5							
	2	ML	SILT, low plasticity, brown, pale brownm red-brown, with fine sand, trace of clay.	D-SM	VSt			
	2.5						DS BH25-C	SPT 2.5-2.95m, N=14
	3							
	3.5							
	4	SM	Sandy SILT / Silty SAND, low plasticity, very fine grained, pale grey.	SM				SPT 4.0-4.45m, N=14
	4.5							
	5		Silty SAND, very fine grained, interbeds of pale grey and orange-brown.	W	L			
	5.5							SPT 5.5-5.95m, N=9
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: Track Mounted Hanjin D&amp;B

Surface RL: 25.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
		SP		W				
	6.5	SM-SP	As above, becoming more sandy		MD			
	7							SPT 7.0-7.45m, N=15
	7.5							
	8							
	8.5							Could not conduct SPT at 8.5m due to collapse of saturated sand.
	9							
	9.5							
	10	GP	GRAVEL, medium grained to cobble sized, sub-rounded.		D			
			Borehole terminated at 10m					Auger refusal on GRAVEL.
	10.5							
	11							
	11.5							
	12							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.5m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	Dry	-			TOPSOIL
	1		Admixed Silty Clay, medium plasticity, brown, red-brown.	<Wp			DS BH26-A	FILL Appears compacted.
	1.5						DS BH26-B	
	2							
	2.5	SC	Sandy CLAY, medium plasticity, pale grey, grey, brown.		VSt			ALLUVIUM
	3		As above, dark grey.					
	3.5							
	4		As above, medium to high plasticity, pale grey, yellow-brown.	SM <Wp				
	4.5	SP/ SM	Silty SAND / Clayey SAND, very fine grained, interbeds of pale grey and orange-brown.		MD			
	5							
	5.5			W				
	6		Silty SAND, very fine grained, pale grey, yellow-brown					

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL



Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.5m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5			W	MD			
	7							
			Clayey SAND / Sandy CLAY, very fine grained, pale grey.					
	7.5		Borehole terminated at 7.5m					
	8							
	8.5							
	9							
	9.5							
	10							
	10.5							
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.25m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content.	D	-			TOPSOIL
	1		Admixed Silty Clay, medium plasticity, brown, red-brown.	SM			DS BH27-A	FILL
	1.5							
	2						DS BH27-B	
	2.5							
	3	ML	Sandy SILT, low plasticity, dark brown, brown.		St			ALLUVIUM
	3.5							
	4	CL	Silty CLAY, medium plasticity, yellow-brown, pale grey, with fine sand.					
	4.5							
	5							
	5.5		As above, pale grey, brown, yellow-brown.	M				
	6							

### Explanatory Notes

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H



**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 26.25m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
X	6.5	SM	Silty CLAY, medium plasticity, pale grey, brown, yellow-brown, with fine sand. (contd.)	M	St			
	7		Silty SAND, fine grained, yellow-brown, brown.	W	L			
	7.5							
	8							
	8.5							
	9							
	9.5							
	10							
	10.5		Borehole terminated at 10.5m					Auger refusal on GRAVEL.
	11							
	11.5							
	12							

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: WL

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 24.25m

Sheet 1 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0.5	-	Sandy SILT, brown, with clay and organic content. Clayey SILT, low plasticity, dark brown, brown.	D	-		DS BH28-A	TOPSOIL FILL
	1		Admixed Silty CLAY, medium plasticity, brown, pale brown, pale yellow.				DS BH28-B	
	1.5	ML	SILT, low plasticity, dark brown, brown, with sand.	SM	S-F			ALLUVIUM
	2		Clayey SILT, low plasticity, pale grey, brown.	M				
	2.5							
	3							
	3.5							
	4							
	4.5		Sandy SILT, low plasticity, pale grey, pale yellow.					
	5			VM - W >>Wp				
	5.5							
	6							

### Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H


Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Method: 4WD Mounted rig, solid flight spiral augers

Surface RL: 24.25m

Sheet 2 of 2

Co-ords: -

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5 7 7.5 8 8.5		Sandy SILT, low plasticity, pale grey, pale yellow. (contd.)	VM - W >>Wp	S-F			
	9 9.5 10 10.5 11 11.5 12		Borehole terminated at 8.6m					Auger refusal on GRAVEL

**Explanatory Notes**

**Density / Consistency:** Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD, Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H

**Moisture Condition:** Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

## **APPENDIX C**

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### **Laboratory Test Results**

## CALIFORNIAN BEARING RATIO

Client	Aspire Panthers Pty Ltd	Job no :	<b>GTE774</b>
Project	Panthers North Precinct	Test date :	<b>1-Mar-16</b>
Location	Penrith	Report No.	<b>GTER774-L1</b>

Sample Number	L1	L2	L3	
Date Sampled	24-Feb-16	24-Feb-16	24-Feb-16	
Depth	0.1-1.0m	0.1-1.0m	0.1-1.0m	
Location	BH5	BH16	BH22	

### Laboratory Compaction AS1289 5.1.1 standard

Oversize Material 19mm Sieve	%	0.2	0.2	1.2	
Maximum Dry Density	t/m <sup>3</sup>	1.95	1.85	1.81	
Optimum Moisture Content	%	10.6	13.2	14.6	
Field Moisture Content	%	8.4	9.0	10.5	

### Test Results AS 1289 6.1.1

<b>Before Soaking</b>	Dry Density t/m <sup>3</sup>	1.95	1.86	1.82	
	Moisture Ratio %	98.0	98.5	98.5	
	Density Ratio %	100.0	100.0	100.5	
<b>After Soaking</b>	Dry Density t/m <sup>3</sup>	1.95	1.84	1.78	
	Moisture Content %	12.0	15.5	17.4	
	Moisture Content after test - remainder	11.5	14.4	17.8	
	Moisture Content after test - top 30mm	11.5	16.1	20.5	
	Number of days soaking	4	4	4	
	Mass of Surcharge	4.5	4.5	4.5	
	Swell after soaking	0.0	1.0	2.0	
	CBR penetration	5.0	5.0	5.0	
<b>CBR VALUE</b>	%	<b>17</b>	<b>9</b>	<b>3.5</b>	

Material Description : L1: Brown Clayey Sand with some Gravel, L2: Brown Gravelly Silty Clay with some Sand  
L3: Brown Clay with some Gravel

Notes : Material Retained on 19mm Sieve was Excluded from Tests L1-L3

Test Methods: AS1289 6.1.1, 5.1.1, 2.1.1 Sampling : AS1289 1.2.1 (6.5.3)



NATA Accredited Laboratory No. 14343  
Accredited for compliance with ISO/IEC 17025

*Khell El*

Approved Signatory  
Date

16-Mar-16

**Particle Size Distribution & Clay content**Client: **Aspire Panthers Pty Ltd**Job No. **GTE774**Project: **Panthers North Precinct**Date: **2-Mar-16**Location: **Penrith**Report No. **GTER774-L2**Lab Reference No. **L 4**Sample Identification: **BH4, 2.0-3.0m**Laboratory Specimen Classification: **Brown Silty Clayey Sand****Particle Size Distribution**

AS1289 3.6.3

**Consistency Limits and Moisture Content**

Sieve Size	% Passing	Specification	Test	Method	Result	Spec.
19.0 mm	100		Liquid Limit	% AS1289 3.1.2	ND	
13.2 mm	100		Plastic Limit	% AS1289 3.2.1	ND	
9.5 mm	100		Plasticity Index	% AS1289 3.3.1	ND	
6.7 mm	100		Linear Shrinkage	% AS1289 3.4.1	ND	
4.75 mm	100		Moisture Content	% AS1289 2.1.1	ND	
2.36 mm	100		Sample History:			
1.18 mm	100		Preparation Method:			
600 um	100		Crumbling / Curling of linear shrinkage:			
425 um	98		Linear shrinkage mould length:			
300 um	89		ND = not determined NO = not obtainable NP = non plastic			
150 um	65					
75 um	49					
hydrometer values						
33 um	48					
17 um	42					
12 um	40					
8 um	37					
6 um	36					
1 um	25					

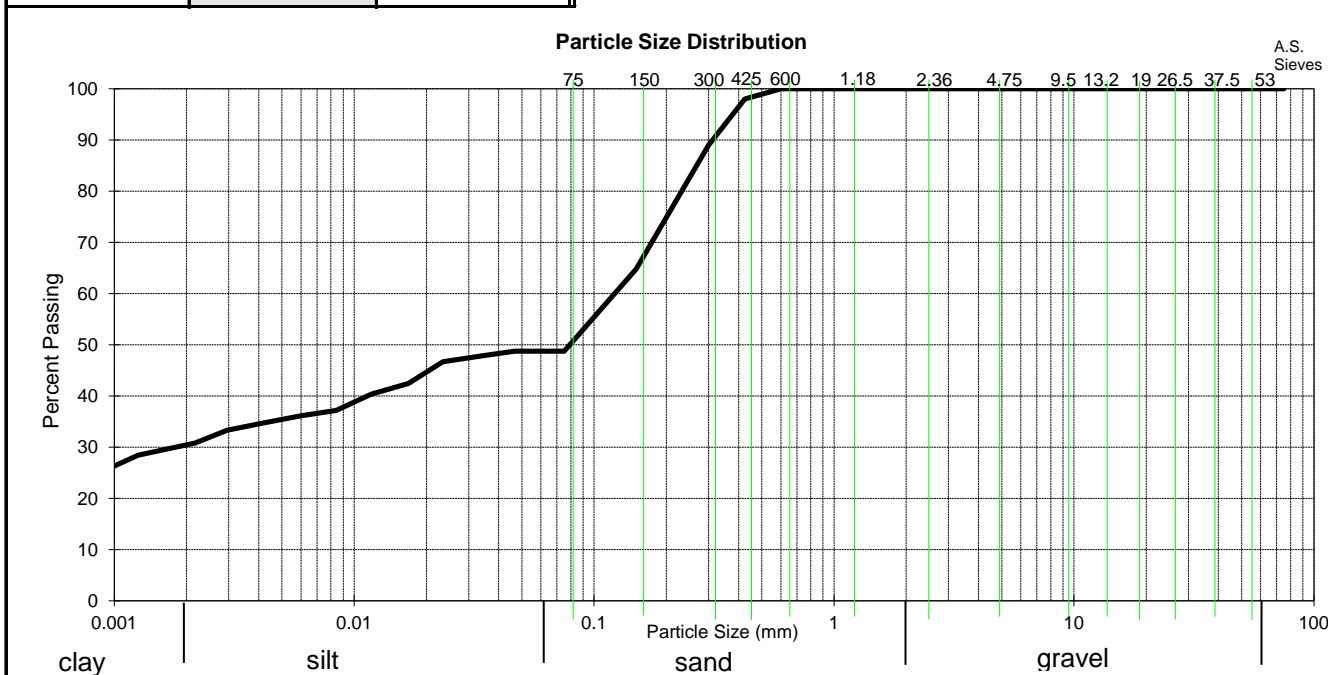
**Notes**

Dispersion : mechanical / hydrometer: g/l

Sampling : AS1289 1.2.1 (6.5.3)

**Material properties**

GRAVEL CONTENT = 0 %  
 SAND CONTENT = 52 %  
 SILT CONTENT = 18 %  
 CLAY CONTENT = 30 %



Laboratory accreditation No. 14343



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*Khell El*



**Particle Size Distribution & Clay content**Client: **Aspire Panthers Pty Ltd**Job No. **GTE774**Project: **Panthers North Precinct**Date: **2-Mar-16**Location: **Penrith**Report No. **GTER774-L3**Lab Reference No. **L 5**Sample Identification: **BH16, 1.3-2.0m**Laboratory Specimen Classification: **Brown Silty Clayey Sand****Particle Size Distribution**

AS1289 3.6.3

**Consistency Limits and Moisture Content**

Sieve Size	% Passing	Specification	Test	Method	Result	Spec.
19.0 mm	100		Liquid Limit	% AS1289 3.1.2	ND	
13.2 mm	100		Plastic Limit	% AS1289 3.2.1	ND	
9.5 mm	100		Plasticity Index	% AS1289 3.3.1	ND	
6.7 mm	100		Linear Shrinkage	% AS1289 3.4.1	ND	
4.75 mm	100		Moisture Content	% AS1289 2.1.1	ND	
2.36 mm	100		Sample History:			
1.18 mm	100		Preparation Method:			
600 um	99		Crumbling / Curling of linear shrinkage:			
425 um	99		Linear shrinkage mould length:			
300 um	96		ND = not determined NO = not obtainable NP = non plastic			
150 um	83					
75 um	57					
hydrometer values						
32 um	55					
17 um	48					
12 um	46					
8 um	43					
6 um	42					
1 um	31					

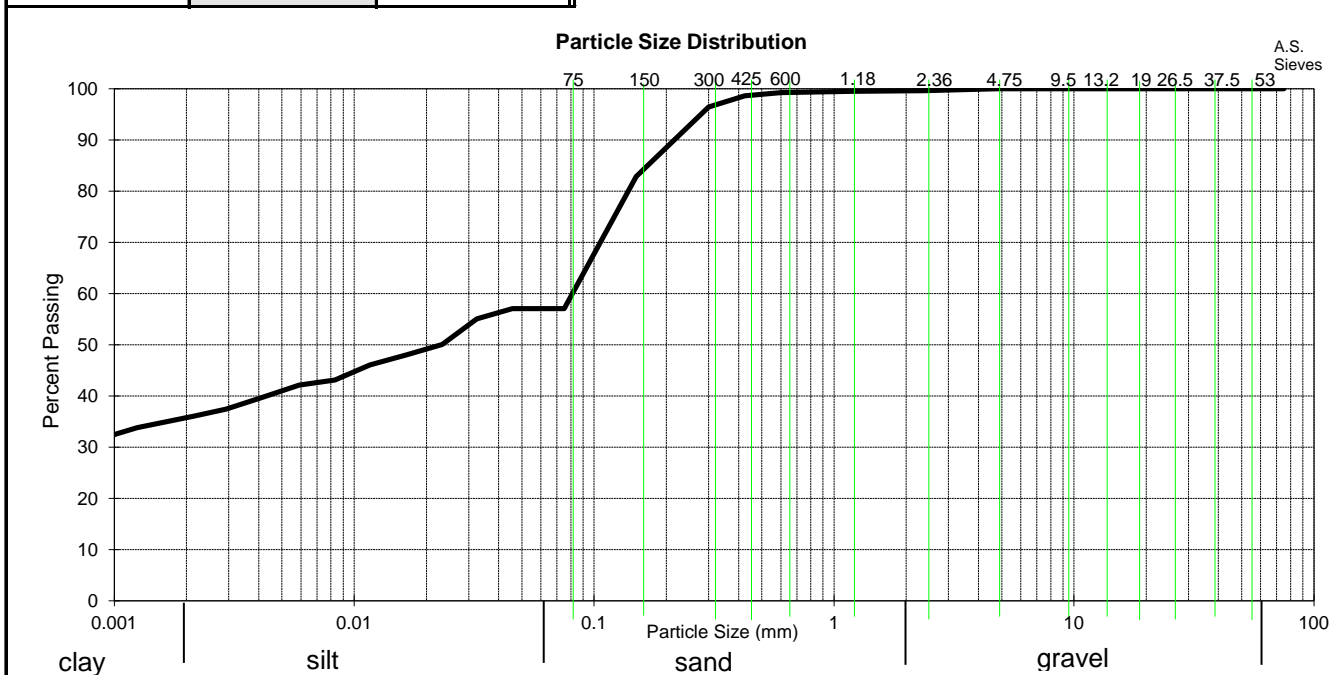
**Notes**

Dispersion : mechanical / hydrometer: g/l

Sampling : AS1289 1.2.1 (6.5.3)

**Material properties**

GRAVEL CONTENT = 0 %  
 SAND CONTENT = 43 %  
 SILT CONTENT = 21 %  
 CLAY CONTENT = 36 %



Laboratory accreditation No. 14343

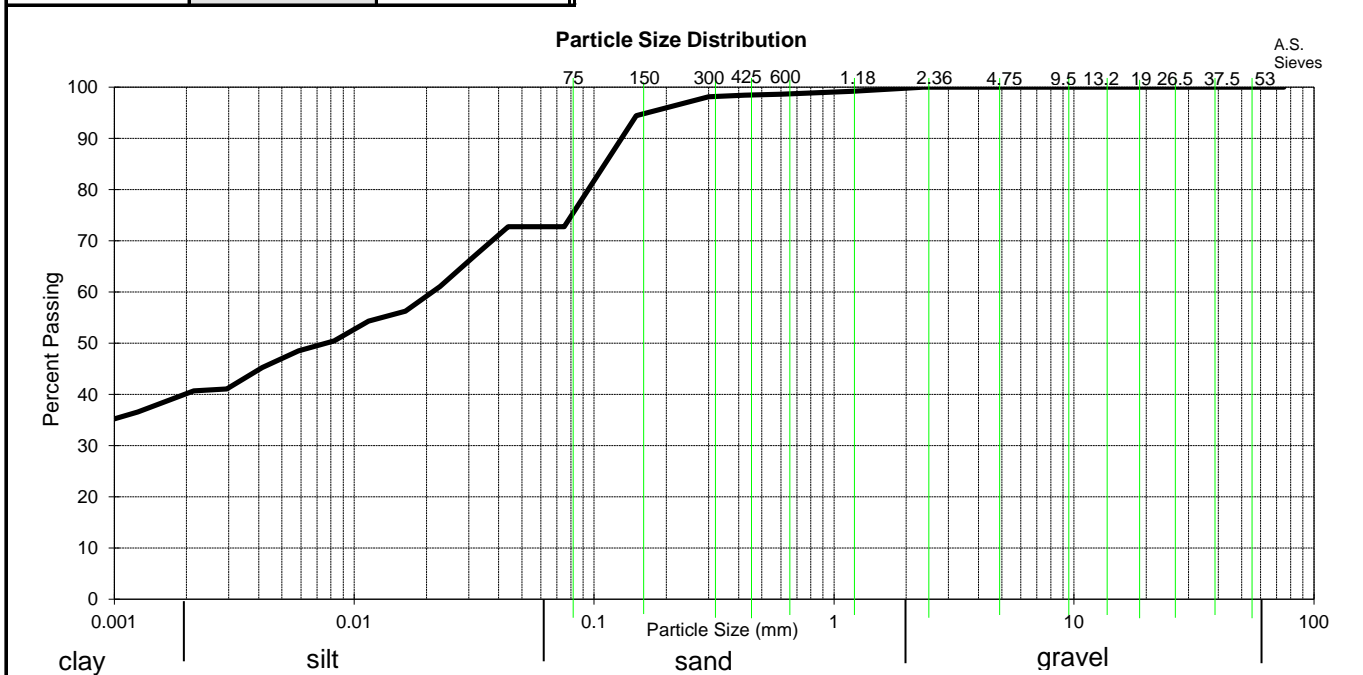


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**Particle Size Distribution & Clay content**

Client: <b>Aspire Panthers Pty Ltd</b>			Job No. <b>GTE774</b>			
Project: <b>Panthers North Precinct</b>			Date: <b>2-Mar-16</b>			
Location: <b>Penrith</b>			Report No. <b>GTER774-L4</b>			
Lab Reference No. <b>L 6</b>		Sample Identification: <b>BH16, 2.2-3.2m</b>				
Laboratory Specimen Classification: <b>Brown Sandy Silty Clay</b>						
<b>Particle Size Distribution</b> AS1289 3.6.3			<b>Consistency Limits and Moisture Content</b>			
Sieve Size	% Passing	Specification	Test	Method	Result	Spec.
19.0 mm	100		Liquid Limit	% AS1289 3.1.2	ND	
13.2 mm	100		Plastic Limit	% AS1289 3.2.1	ND	
9.5 mm	100		Plasticity Index	% AS1289 3.3.1	ND	
6.7 mm	100		Linear Shrinkage	% AS1289 3.4.1	ND	
4.75 mm	100		Moisture Content	% AS1289 2.1.1	ND	
2.36 mm	100		Sample History: Air Dried			
1.18 mm	99		Preparation Method: Dry sieved			
600 um	99		Crumbling / Curling of linear shrinkage: NA			
425 um	98		Linear shrinkage mould length: NA			
300 um	98		ND = not determined NO = not obtainable NP = non plastic			
150 um	94		<b>Notes</b> Dispersion : mechanical / hydrometer: g/l			
75 um	73		Sampling : AS1289 1.2.1 (6.5.3)			
hydrometer values			<b>Material properties</b>			
32 um	67		GRAVEL CONTENT = 0 %			
16 um	56		SAND CONTENT = 27 %			
11 um	54		SILT CONTENT = 33 %			
8 um	50		CLAY CONTENT = 40 %			
6 um	48					
1 um	34					



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*Keith El*