Alliance Geotechnical

Engineering | Environmental | Testing

Manage the earth, eliminate the risk

Geotechnical Investigation Report

Prepared for NSW Department of Education & Communities

Proposed Redevelopment ISHS – Inner City High School
200 Chalmers Street, Surry Hills NSW

Project Number: 2187
Report Number: 2187-GR-1-1
Report date: 26th February 2016
Attention: Mr Ted Kvasnicka
Root Projects Australia

We give you the right information to make the right decisions

Alliance Geotechnical Pty Ltd - Phone: 1800 288 188 - Web: www.allgeo.com.au

TABLE OF CONTENTS

1 INTRODUCTION AND SCOPE

This report presents the findings of a preliminary geotechnical investigation undertaken by Alliance Geotechnical Pty Ltd (AG) at the site of Cleveland Street Intensive English High School / Inner City High School (ISHS), located at No. 200 Chalmers Street, Surry Hills, NSW.

It is understood that redevelopment of the school is proposed and will involve demolition of a building alongside the western site boundary, with heritage buildings on the northern, eastern and southern boundaries to be kept intact.

The new building design is understood to be still finalised and concept preliminary plans were prepared for the proposed building with a footprint of approximately 1467m^2. Two design options comprising students' and staff accommodation with atrium and gymnasium in a fourteen storey building as per SEARs are proposed for the redevelopment of the western portion of the ISHS site.

Geotechnical investigation was undertaken to provide information for the design of the new building footings, lot classification, and preliminary geotechnical recommendations. The main objectives of the investigation were to assess the surface and subsurface conditions and provide comments and recommendations relating to:

- Site classification and existing geotechnical conditions
- Suitable foundations and groundwater conditions
- Retaining structures parameters and excavations
- Temporary batters and vibration control
- Allowable bearing pressures and geotechnical profile

In order to achieve the project objectives, the following scope of work was carried out:

- Walkover observations of site conditions
- Underground services locating carried out by a specialised contractor
- Two (2) geotechnical and additional six (6) environmental boreholes drilled across the site including rock coring of the underlying bedrock
- Laboratory testing of recovered samples
- Engineering assessment and reporting

The results of the required environmental and contamination assessment carried out on this site by AG environmental consultants are presented in a document 2187/ER-1-1 provided by AG. The findings of a field geotechnical drilling assessment are presented in this geotechnical report together with comments on geotechnical parameters.

The results of previous geotechnical investigations if undertaken on this site were not available at the time of preparation of our geotechnical report. The technical preliminary concept drawings of the proposed building prepared by Perumal Pedavoli, together with current survey plan and survey drawings Reference No. 57286, Issue "A", CAD files 57286001A, 2A, 3A. DWG, dated 22/06/15, 16/07/15 and prepared by Hill & Blume Consulting Surveyors were made available to AG.

It should be noted that AG field scope of work was limited to accessible locations approved by current occupier ISHS. It is further noted AG preliminary geotechnical assessment with main scope of work to establish geotechnical parameters for this site is expected to be followed by additional geotechnical investigation to allow for complex and detailed structural design to be prepared. This second phase detailed geotechnical assessment with additional number of boreholes is recommended to be carried out when site conditions will allow for expanded field investigation before the final structural designs will be produced.

The limitations inherent in the current geotechnical site investigation and the importance of verifying the encountered subsurface conditions are inferred herein during the further design stages.

2 SITE DESCRIPTION AND REGIONAL GEOLOGY

The site is identified as No. 200 Chalmers Street, Surry Hills (Lot 8 in DP821649, Lot 1 in DP797484, Lot 1 in DP797483) with total area of approximately 5695m^2 and located on the corner block of land between Cleveland Street and Chalmers Street to the north-west. The site is bounded by above streets and leisure park areas to the north and west, with Central railway station located approximately 200m towards the north. The site is approximately rectangular in shape with slopes from the south (Cleveland Street) to the north at about 5^o to 8^o. The surrounding terrain slopes generally to the north and west with the site located on the upper slopes of grassed park areas to the north of Cleveland Street.

The 1:100,000 NSW Department of Mineral Resources Geological Map of the Sydney Region indicates that the site is located on the border between geological formations to the south-west underlain by the Ashfield Shales (Rwa) of the Wianamatta Group, and to the north by Quaterrnary Cainozoic Holocene deposits (Qhd) *Medium to fine grained "marine" sand with podzols* overlying shale bedrock. Ashfield Shale is indicated to comprise *Black to dark grey shale and laminite.*

Figure 1 - General Locality

3 FIELDWORK

3.1 Fieldwork Methods

The field geotechnical and environmental investigation was undertaken on the 21st January 2016 and comprised drilling of two (2) geotechnical boreholes using a track mounted Comacchio MC-T200 drilling rig operated by Terratest, and six (6) environmental boreholes using a Digga 200 ute mounted drilling rig operated by Sydney Geotechnics. The geotechnical boreholes were drilled using 100mm solid flight augers fitted with a TC (Tungsten Carbide) drill bit and incorporated Standard Penetrometer Tests (SPT) at regular

intervals. Rotary NMLC coring of bedrock was undertaken at both borehole BH1 and BH7 locations to recover rock core samples for laboratory strength testing. A senior geotechnical engineer from AG was responsible for directing insitu testing, tactile assessment and logging of the subsurface strata profile and undertaking soil sampling. The approximate borehole locations are shown on the attached Drawing 2187-GR-1-A, which includes environmental borehole locations.

The depths of the boreholes were adjusted during the field investigation to allow for assessment and design parameters for building foundations and proposed partial basement cut excavations. Groundwater levels were monitored during the drilling and all the boreholes were reinstated with displaced soils and backfilled after the investigation.

Soil samples were collected on the site for further analysis in a NATA registered Alliance Geotechnical laboratory. Laboratory testing on retrieved rock samples to determine rock strength by Point Load Index tests was carried out in our soil testing laboratory. Soil samples were collected during the drilling environmental investigation for external chemical laboratory soil chemical analysis.

3.1 Subsurface Profiles

Locations of the drilled geotechnical and environmental boreholes were proposed by design engineers and project managers, with minor adjustments made during the field investigation on the site. The geotechnical boreholes BH1 and BH7 indicated the soil profiles at the borehole locations comprised of the following:

BH1

- Asphaltic Concrete – 50mm thickness.
- Pavement Fill – Roadbase, dark grey, fine to coarse crushed rock gravel, 250mm thickness
- Fill – Gravelly Silty Clay, mixed with sand and gravel, brown and grey, assessed to be loose and not compacted or poorly compacted, encountered in BH1 to 1.5m depth below ground level (bgl).
- Sand – fine to medium, brown and yellow, trace of fine gravel, to the depth of 2.1m bgl.
- Sandy Silty Clay – Alluvial, medium to high plasticity, brown/red and grey, moist, assessed to be stiff, encountered to 2.8m depth bgl.
- Silty Clay – Residual, high plasticity, red and brown, with ironstone gravel, moist, assessed to be very stiff becoming hard below 5m, and encountered in BH1 to the depth of 5.4m bgl.
- Interbedded Soil/Rock layer – Shaly Clay and Siltstone/Shale, from 5.4m to 6.4m depths bgl.
- Shale – Extremely weathered, brown and grey, assessed to be of extremely low strength Class V, moist, with clay bands, encountered at the depth of 6.4m and extended to the 8.2m depth.
- Shale – Highly weathered, grey and dark grey, assessed to be of very low strength Class V, with clay bands, encountered at the depth of 8.2m and drilled to the 9.6m depth of TC bit refusal.
- Shale - Highly weathered, dark grey with grey laminations, progressed with NMLC rock coring within the bedrock profile from 9.6m to the maximum depth of 11.81m in BH1. Shale bedrock was tested and assessed low to medium strength, Class IV from 9.6m to 10.2m, and Class IV/III from 10.2m to 11.81m.

BH7

- Asphaltic Concrete – 50mm thickness.
- Pavement Fill – Roadbase, dark grey, fine to coarse crushed rock gravel, 450mm thickness
- Fill – Gravelly Silty Sand, mixed with gravel and some clay, dark brown and grey, assessed to be loose and not compacted or poorly compacted, encountered in BH7 to 1.4m depth below ground level (bgl).
- Silty Clay – Residual, high plasticity, red and brown, moist, assessed to be stiff to 2m and very stiff below, encountered to 3.5m depth bgl.
- Silty Clay – Residual, medium plasticity, grey, with some shale layers, moist, assessed to be very stiff to hard, and encountered in BH7 to the depth of 4.4m bgl.
- Interbedded Soil/Rock layer – Shaly Clay and Siltstone, from 4.4m to 6.0m depths bgl.
- Shale – Extremely weathered, brown and grey, assessed to be of extremely low strength Class V, moist, with clay bands, encountered at the depth of 6.0m and extended to the 7.6m depth.
- Shale – Highly weathered, grey and dark grey, assessed to be of very low strength Class V, with clay bands, encountered at the depth of 7.6m and drilled to the 8.5m depth of near TC bit refusal.

- Shale - Highly weathered, dark grey with grey laminations, progressed with NMLC rock coring within the bedrock profile from 8.5m to the maximum depth of 10.85m in BH7. Shale bedrock was tested and assessed low to medium strength, Class IV from 8.5m to 9.8m, and Class IV/III from 9.8m to 10.85m.

3.2 Groundwater

Groundwater was encountered in the drilled boreholes BH1 and BH7. Slight seepages were recorded in BH1 (9.5m depth bgl, approximate RL 17.6m AHD) and in BH7 (8.4m depth bgl, approximate RL 20.1m AHD).

The observed seepages were assessed to be occurring in the extremely weathered shale profile approximately at the transitional layer between Class V and Class IV shale bedrock. Groundwater monitoring standpipes were not installed on site and the use of water as a drilling fluid during coring prevented accurate measurements after drilling when coring was finished on the site.

Seepages inflow water levels were measured in the boreholes before coring and increased water flows are expected to occur at the weathered shale profile and along defects in the shale bedrock after adverse weather conditions and during periods of heavy rainfall.

4 LABORATORY TESTING

Following the field investigation, rock samples collected were tested at AG's NATA accredited laboratory for Point Load Strength testing (I_{S50}) with the results recorded on borehole log sheets attached. Laboratory testing was performed on selected rock core samples from BH1 and BH7, and the results of the laboratory testing are summarised in Table 1.

Table 1 - Summary of Laboratory Test Results

Borehole	Depth (m)	Is $_{50\ Axial}$ (MPa)	Is $_{50\ Diametric}$ (MPa)	Material Types
BH1	9.95	0.21	-	Shale, highly weathered, dark grey and grey
BH1	10.16	0.39	0.37	Shale, highly weathered, dark grey and grey
BH1	10.93	0.24	-	Shale, highly weathered, dark grey and grey
BH1	11.43	0.18	0.21	Shale, highly weathered, dark grey and grey
BH1	11.71	0.46	0.39	Shale, highly weathered, dark grey and grey

Borehole	Depth (m)	Is $_{50\ Axial}$ (MPa)	Is $_{50\ Diametric}$ (MPa)	Material Types
BH7	8.85	0.13	-	Shale, highly weathered, dark grey and grey
BH7	9.21	0.13	0.27	Shale, highly weathered, dark grey and grey
BH7	9.48	0.23	0.35	Shale, highly weathered, dark grey and grey
BH7	9.65	0.22	0.28	Shale, highly weathered, dark grey and grey
BH7	10.15	0.50	0.52	Shale, highly weathered, dark grey and grey

Notes:
Is $_{50}$ Point Load Strength (converted NMLC core values)

5 COMMENTS AND RECOMMENDATIONS

5.1 Excavation Conditions and Site Classification

Based on the site conditions and the soil profile, the site has been classified as **Class P** in accordance with AS2870-2011 "Residential Slabs and Footings" due to deep uncontrolled fill, as per requirements specified in AS3798 for structural fill for residential applications. Reclassification of filled sites would require controlled fill placement as per AS3798 in accordance with engineering principles. It should be noted that site classification is applicable as per AS2870 to the buildings of less than 30m footprint lengths.

It is understood that the proposed development will involve the demolition of the existing non-heritage building and the construction of new multi-storey building within ISHS site. Preliminary architectural drawings for the proposed structure indicate two options be considered, with limited basement/cut excavations for Games Court/Quadrangle at the base of the building, align with business case outcome option. This would require excavations to approximately 1.5m to 2m below the existing ground level on the upper southern side of the building and possibly less than 1m on the lower northern side. It is imperative that during demolition works and subsequent excavations the existing sandstone and brick heritage buildings in a close proximity to the existing structure must be adequately protected from excessive vibrations as further mentioned.

Based on the subsurface conditions observed in the boreholes it is expected that the excavation of the partial basement will encounter, after removing asphaltic layers and pavement roadbase fill, mainly gravelly clay/sand fill layers of loose (poorly compacted) consistency. Any existing fill material, topsoil, vegetation, building rubble with deleterious materials including demolished building old footings, pavements and underground services, should be stripped and removed off the site. Excavation of the loose fill layers is expected to be feasible using conventional earthmoving equipment such as backhoes or excavators.

Surcharge loadings from heritage buildings must be considered during the design of retaining structures if founded within the zone of influence of subject excavations. The zone of influence is defined as a geometrical plane projected from the toe of the excavation upwards in direction to the retained ground surface from horizontal plane. The depth of foundations for the neighbouring heritage buildings should be ascertained prior to design of the retaining structures and excavations. Consideration should be given to supporting or underpinning heritage structures prior to commencing excavation works.

At the time of writing, only concept drawings were available, and offset distances of excavations to existing structures was unknown, though it is expected that the excavations for the proposed building partial basement will require shoring within the upper fill soil layers due to loose (weak) consistency of the fill encountered. The design of temporary retaining structures may be incorporated into the permanent excavation support and the use of temporary anchors is not likely considered to be necessary for the proposed partial basement design.

Dilapidation survey is strongly recommended to be undertaken for the existing heritage buildings and the dilapidation survey must cover Roads and Maritime Services (RMS) assets if found within the influence zone of the proposed excavation.

5.2 Groundwater Control

Groundwater in the form of seepage was encountered during the auger component of the drilling investigation at approximately 9.5m in BH1 and 8.4m in BH7. No long term monitoring of groundwater levels was undertaken at the site.

On the basis of our findings it is not anticipated groundwater levels or seepages will have an adverse impact on the proposed excavation. It is possible that during piling works potential groundwater seepages from Class V underlying shale may prohibit bored cast insitu concrete piles depending on the volume of groundwater seepage encountered, thereby grout injected and/or cased piles or other options will have to be considered.

It should be noted groundwater levels may fluctuate due to rainfalls and seasonal weather conditions and the conditions across the surrounding landscape. It is recommended potential seepage water levels be

investigated if construction is undertaken during or following adverse weather or if a significant time period lapse between AG current investigation and construction commencement.

5.3 Temporary Batter Slopes and Earth Pressure Parameters

Temporary batter slopes could be appropriate for the proposed excavation provided that the excavation is set back sufficiently from the site boundaries and heritage buildings or sufficient controls in place to protect adjacent structures. The not retained excavations in loose (weak) fill should not extend below the 'zone of influence' of adjacent structures. Recommended maximum slopes for permanent and temporary batters are presented in Table 2 below:

Table 2 - Recommended Maximum Batter Slopes

Material	Maximum Batter Slope (H : V)	
	Permanent	Temporary
Fill Layers – Gravelly Clays	N/A	2 : 1
Stiff to Very Stiff Silty Clays	N/A	1 : 1
* subject to inspection by a Geotechnical Engineer and carrying out remedial works if recommended (shotcrete, rock bolting).		

It is emphasised that not retained excavations should not extend below the 'zone of influence' of adjacent structures, i.e. that a line drawn 45° (for natural clays, or alternatively drawn 30° for encountered fill layers) down from the foundation level of adjacent structures or features (including paths, fences, stairs etc). If the excavations are to extend below this line then they must be retained prior to start of works.

Where there is insufficient space for batter construction, the excavation face should be supported by means of temporary or permanent retaining walls. These structures should be designed to withstand the applied lateral pressures of the subsurface soils layer, the existing surcharges in their zone of influence, and hydrostatic pressures if appropriate, using a triangular earth pressure distribution and following formula:

$$p_h = \gamma k H + qk$$

where:

- p_h = Horizontal pressure (kN/m^2)
- γ = Unit weight of soil (kN/m^3)
- k = Coefficient of earth pressure (k_a or k_o)
- H = Retained height (m)
- q = Surcharge pressure behind retaining wall (kN/m^2)

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure coefficient is recommended. Should it be critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest should be considered.

5.4 Retaining Structures Design Parameters

The only preliminary concept drawings for the partial basement were available at the time of AG investigation and assessment.

Preliminary design would indicate the proposed partial basement will be directly adjacent to the heritage ISHS buildings with car parking options and gymnasium. Thus, the basement walls and excavation faces must have suitable support designed for combining short term and long term loadings of the final structure.

The supporting structures should be designed to withstand the applied lateral pressures of the subsurface loose (weak) fill and underlying natural soil layers, the existing surcharges in their zone of influence, and hydrostatic pressures.

Recommended parameters for the design of earth retaining structures are provided in Table 3 below.

Table 3 – Preliminary Geotechnical Design Parameters

	Fill – Gravelly Silty Clay with Sand	Stiff to Very Stiff Clays	Extremely Low Strength Class V Shale
Ka	0.38	0.38	0.38
Ko	0.58	0.58	0.58
Poisson Ratio (v)	0.3	0.3	0.3
Effective Internal Friction Angle (degrees)	25	25	25
Effective Cohesion (kPa)	0	2	25
Effective Unit Weight (kN/m^3)	17	18	21

5.5 Foundations

The preliminary architectural concept drawings indicate that approximate design level of the proposed partial basement floor slab is approximate RL 26.5m – 27m [AHD]. It is not anticipated shallow foundations will be possible for the main building, though they can be utilised for additional light weight structures on the site, if required. Deep piles founding in Class III/IV Shale are regarded as preferred option for the proposed building structure.

Shallow foundations as pad or strip footings (additional structures), and deep piles (main building) are considered applicable for the proposed redevelopment. Approximate RL (m) levels in AHD for strata layers encountered during investigation, as estimated from supplied survey plan and drawings, can be found in Table 4 below:

Table 4 – Approximate Estimated RL of Strata Profile for BH1 and BH7

	Surface Levels AG Boreholes Depth RL (m AHD)	Residual Very Stiff Silty Clays Start Depth RL (m AHD)	Interbedded Clays / Rock Layer Start Depth RL (m AHD)	Class V Shale Layer Start Depth RL (m AHD)	Class IV/III Shale Layer Start Depth RL (m AHD)
BH1	27.1	24.3	21.7	20.7	16.9
BH7	28.5	26.0	24.1	22.5	18.7

A maximum allowable bearing capacity of **2500kPa** may be adopted for footing systems founded within the Class IV/III shale in accordance with the guidelines provided by Pells et al. A maximum allowable shaft adhesion of 250kPa can be applied to clean sockets within the rock strata. Shaft adhesion should be reduced or ignored if the socket lengths are smeared or fail to satisfy the socket requirements. Concrete should be placed within 24 hours of excavation as the weathered bedrock may deteriorate rapidly upon exposure.

The upper strata layer of Class V shale can be allowed for a maximum allowable bearing capacity of 700kPa, and intermediate shale Class IV layer for a maximum allowable bearing capacity of 1000kPa. The residual very stiff clays strata encountered below the existing ground in BH1 and BH7 at the approximate depths 2.8m and 2.5m (bgl) respectively, if utilised in the foundations design, can adopt a maximum allowable bearing capacity of 200kPa.

Table 5 below provides recommended allowable vertical bearing pressures for design of footings for structures founding at various depths below ground level.

Table 5 – Foundation Design Parameters

	Very Stiff Clayey Soils	Class V Shale	Class IV Shale	Class IV/III Shale
Estimated Depth from Existing Ground Level	2.8m(BH1) 2.5m(BH7)	6.4m(BH1) 6.0m(BH7)	9.6m(BH1) 8.5m(BH7)	10.2m(BH1) 9.8m(BH7)
Allowable Bearing Pressure (kPa)	200	700	1000	2500

High level or deep piled footings are both considered appropriate if following conditions are adhered to during the construction:

- The loads of the proposed building are to be taken below proposed excavation levels
- Deep footings founded in Class V, IV or IV/III shale bedrock should be taken and founded in similar bearing materials to minimise the effects of differential settlements
- All footing excavations should be free of loose debris and wet spoil prior to pouring concrete
- The quality of the founding materials for all footing excavations should be assessed by a structural or geotechnical consultant/engineer

5.6 Limiting Factors and Vibration Control

It is understood that it may be necessary to limit construction vibrations close to vibration sensitive structures with emphasis on the heritage buildings adjacent to the proposed building. It is recommended the excavation works be complemented in a manner that heavy machinery would not be required to be used within 1m of the site boundaries to limit vibrations. Earthworks machines may be used with restrictions as stated further and it should be noted that below constraints apply to the size of vibrations generating equipment and not the size of excavator that may be used on this site. Peak particle velocity in mm/s is often the adopted measure of ground vibration and values are given in Table 6 below for three common types of structures. The peak velocity limits should reduce the risk of causing damage to adjacent structures:

Table 6 - Peak Particle Velocity for Various Structures

Category	Type of Structure	Peak Particle Velocity mm/s
1	Historic Building or Monument	2
2	Residential and Low Rise Buildings	5
3	Commercial and Industrial Buildings or Structures of Reinforced Concrete Construction	10

Excavation methods should be adopted which limit ground vibrations at the adjoining heritage buildings and sensitive structures to not more than 2mm/s. The limit of 2mm/sec is expected to be achievable if earthworks equipment or other excavation methods are restricted as indicated in Table 7 as follows:

Table 7 - Recommendations for Rock Breaking Equipment

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 2mm/sec	
	Equipment	Operating Limit (% of Maximum Capacity)
1.0 to 2.0	Hand tool and Hand operated Jackhammer only	100
3.0 to 5.0	1.5t Hydraulic Hammer	100

During the excavation equipment must be operated by qualified and experienced personnel in accordance to the manufacturer's instructions and in a manner consistent with minimising vibration effects.

6 Limitations

Alliance Geotechnical Pty Ltd (AG) has prepared this report for this project at ISHS Surry Hills in accordance with AG's proposal to Root Projects Australia email dated 9th November 2016. The works were undertaken under AG's Terms of Engagement. This report has been prepared for NSW Department of Education & Communities, care of Root Projects Australia and their project managers for this project and for the purposes outlined in this report. It should not be relied upon for other projects, or other parties on the site or other site. Any party relying on this report outside its exclusive use as stated herein and without AG's consent does so entirely at their own risk and without any recourse to AG for any loss or damage.

The results provided in this report are indicative of the subsurface conditions on site only at the specific sampling or testing locations and only to the depths investigated at the time the works were undertaken. Subsurface conditions can change significantly due to geological and human processes. This advice may also be limited by budget constraints imposed by others or site accessibility.

The assumptions in this report cannot be substantiated until earthworks and/or foundation construction is near completion. Where variations in conditions are encountered further geotechnical advice should be sought after.

Should you need any further information, please do not hesitate to contact us.

Regards

Reviewed

Lubos Melicharek BE (Mining/Geology)
Senior Geotechnical Engineer
Alliance Geotechnical Pty Ltd

Charlie Sleiman BE (Civil)
Senior Geotechnical Engineer
Alliance Geotechnical Pty Ltd

REFERENCES AND ATTACHMENTS

References

- AS1726-1993 - Geotechnical Site Investigations
- AS2870-2011 - Residential slabs and Footings Construction
- Pells et al “Foundations on Sandstone and Shale in the Sydney Region” AGJ, 1998
- The 1:100,000 NSW Department of Mineral Resources Geological Map of the Sydney Basin

Attachments

- Site Images
- Drawing: 2187-GR-1-A
- BH1 and BH7 Core Photos
- Borehole Logs (2) and Cored Borehole Logs (2)

Core Photos

Figure 2 – BH1 Core Photo

Figure 3 – BH7 Core Photo

Site Images

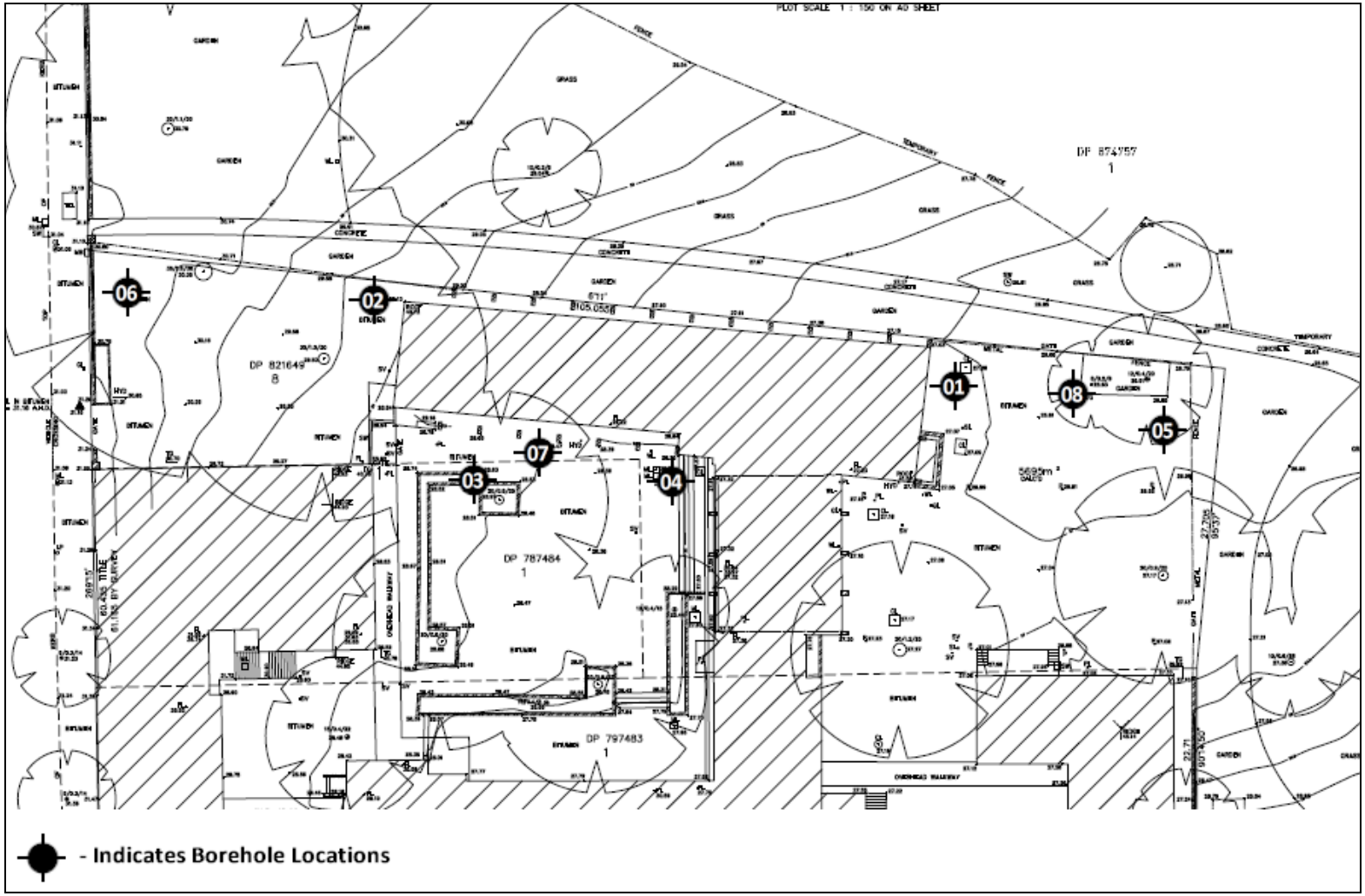
Figure 2 - BH1 Investigated Location

Figure 3 – BH7 Investigated Location

Alliance Geotechnical Pty Ltd
ENGINEERING | ENVIRONMENTAL | TESTING

Test Locations - Drawing Number: 2187-GR-1-A

Not To Scale



Source: Hill & Blume Consulting Surveyors, Ref: 57286

BH No: BH 1
PAGE 1 OF 2
Job No: 2187

Borehole Log

Client: NSW Department of Education
Project: Proposed ISHS Redevelopment Project
Location: 200 Chalmers Street, Surry Hills, NSW

Started: 21-1-16
Finished: 21-1-16
Borehole Size: 100mm diameter

Rig Type: Com MC-T200 **Driller:** M Rana **Angle From Horizontal:** **Logged:** LM
RL Surface: 27.1 **Contractor:** Terratest Pty Ltd **Bearing:** --- **Checked:** TD

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT						ASPHALTIC CONCRETE 50mm thickness		D		PAVEMENT
						FILL: Roadbase, dark grey, fine to coarse crushed rock gravel, trace of clay and silt, well compacted	Enviro Sample	M		FILL
		26				FILL: Gravelly Silty Clay, mixed with some sand, brown and grey with red mottling, fine to coarse gravel, clay of medium plasticity, appears poorly compacted	Enviro Sample			
							SPT 3, 3, 4 N=7			
			2		SP	SAND, fine to medium, brown and yellow, trace of fine gravel	Enviro Sample	M	L	AEOLIAN
					CI - CH	Sandy Silty CLAY, brown/red and grey, medium to high plasticity, with fine to coarse gravel, trace of organics (roots)		M	St	ALLUVIAL
							SPT 5, 6, 6 N=12			
		24			CH	Silty CLAY, red and brown with grey mottling, high plasticity, with fine to coarse ironstone gravel		M	VSt	RESIDUAL
			4							
							SPT 5, 7, 12 N=19			
		22							H	
			6			INTERBEDDED Shaley Clay and extremely weathered Siltstone / Shale, grey and brown, with some orange/yellow bands		M		INTERBEDDED SOIL/ROCK
						SHALE, extremely weathered, brown and grey, with frequent clay bands, extremely low strength		M		BEDROCK
		20								
			8							
	Very Slight Seepage					SHALE, highly weathered, grey and dark grey, with frequent shaley clay bands, very low strength		M		
		18								
			10			Borehole BH 1 continued as cored hole				
		16								
			12							

BH No: BH 1
PAGE 2 OF 2
Job No: 2187

Cored Borehole Log

Client: NSW Department of Education
Project: Proposed ISHS Redevelopment Project
Location: 200 Chalmers Street, Surry Hills, NSW

Started: 21-1-16
Finished: 21-1-16
Borehole Size: 100mm diameter

Rig Type: Com MC-T200 **Driller:** M Rana **Angle From Horizontal:** **Logged:** LM

RL Surface: 27.1 **Contractor:** Terratest Pty Ltd **Bearing:** --- **Checked:** TD

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30, 100, 300, 1000, 3000)	Additional Data
		26	2								
		24	4								
		22	6								
		20	8								
		18			Continued from non-cored borehole						
NMLC			10		SHALE, highly weathered, dark grey, with some grey laminations	HW		A 0.21	66		9.60, EW Seam, 60mm t.
								D 0.39 A 0.37			9.89, Joint, 30°, planar
					SHALE, highly weathered, dark grey, with grey laminations						10.06, Joint, 20°, planar
		16									10.30, Joint, 40°, planar
											10.33, Joint, 40°, planar
											10.40, Joint, 50°, planar
											10.63, Joint, 45°, planar
								A 0.24			10.70, Crushed Seam 200mm
											11.05, Joint, 30°, curved
											11.20, Joint, 45°, planar
								D 0.21 A 0.18			11.29, EW Seam, 80mm t.
											11.46, Clay Seam, 25mm t.
			12		BH 1 terminated at 11.81m			D 0.39 A 0.46			

BH No: BH 7
PAGE 1 OF 2
Job No: 2187

Borehole Log

Client: NSW Department of Education
Project: Proposed ISHS Redevelopment Project
Location: 200 Chalmers Street, Surry Hills, NSW

Started: 21-1-16
Finished: 21-1-16
Borehole Size: 100mm diameter

Rig Type: Com MC-T200 **Driller:** M Rana **Angle From Horizontal:** **Logged:** LM
RL Surface: 28.5 **Contractor:** Terratest Pty Ltd **Bearing:** --- **Checked:** TD

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT						ASPHALTIC CONCRETE 50mm thickness		D		PAVEMENT
		28				FILL: Roadbase, dark grey, fine to coarse crushed rock gravel, with sand and silt, trace of clay, well compacted	Enviro Sample			
						FILL: Mixture of Gravelly Silty Sand, dark brown and grey, with some fine to coarse sandstone gravel, and with some fragments of brick, appears poorly compacted	Enviro Sample SPT 4, 2, 4 N=6	M		FILL
			2		CH	Silty CLAY, red and brown with grey mottling, high plasticity, with fine to coarse ironstone gravel	Enviro Sample	M	St	RESIDUAL
		26					SPT 3, 4, 6 N=10		VSt	
			4		CI	Silty CLAY, grey with brown mottling, medium plasticity, with some layers of extremely weathered brown and grey shale		M	VSt - H	
		24				INTERBEDDED Shaley Clay and extremely weathered Siltstone, light grey, with brown bands	SPT 7, 14, 20 N=34	M		INTERBEDDED SOIL/ROCK
			6			SHALE, extremely weathered, brown and grey, with frequent clay bands, extremely low strength		M		BEDROCK
		22								
	Very Slight Seepage		8			SHALE, highly weathered, grey and dark grey, with frequent shaley clay bands, very low strength		M		
		20								
						Borehole BH 7 continued as cored hole				
		18	10							
			12							

BH No: BH 7
PAGE 2 OF 2
Job No: 2187

Cored Borehole Log

Client: NSW Department of Education
Project: Proposed ISHS Redevelopment Project
Location: 200 Chalmers Street, Surry Hills, NSW

Started: 21-1-16
Finished: 21-1-16
Borehole Size: 100mm diameter

Rig Type: Com MC-T200 **Driller:** M Rana **Angle From Horizontal:** **Logged:** LM

RL Surface: 28.5 **Contractor:** Terratest Pty Ltd **Bearing:** --- **Checked:** TD

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30, 100, 300, 1000, 3000)	Additional Data
		28									
			2								
		26									
			4								
		24									
			6								
		22									
			8								
		20			Continued from non-cored borehole						
NMLC			10		SHALE, highly weathered, dark grey, with some grey laminations	HW		A 0.13 D 0.27 A 0.13 D 0.35 A 0.23 D 0.28 A 0.22 D 0.5 A 0.52	73		8.50, Clay Seam, 70mm t. 8.75, Joint, 50°, planar 8.90, Clay Seam, 20mm t. 8.98, Joint, 45°, planar 9.07, Joint, 40°, planar 9.12, Joint, 40°, planar 9.20, Clay Seam, 20mm t. 9.36, Joint, 50°, planar 9.59, Joint, 30°, with Clay Seam 15mm t. 9.73, Joint, 70°, curved 9.86, Joint, 60°, planar 9.93, Joint, 50°, planar 10.00, Joint, 60°, planar 10.09, Joint, 50°, with Clay Seam 30mm t. 10.30, Joints x 2, 45°, planar 10.47, Joint, 50°, planar 10.60, Joint, 50°, with Clay Seam 30mm t. 10.77, Joint, 60°, planar
		18			SHALE, highly weathered, dark grey, with grey laminations						
			12		BH 7 terminated at 10.85m						

EXPLANATORY NOTES - DRILL & EXCAVATION LOGS

GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavtion of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

DRILLING

Drilling & Casing

AS	Auger Screwing
AD/V	Auger Drilling with V-Bit
AD/T	Auger Drilling with TC Bit
WB	Wash-bore drilling
RR	Rock Roller
NMLC	NMLC core barrel
NQ	NQ core barrel
HMLC	HMLC core barrel
HQ	HQ core barrel

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

VE	Very Easy
E	Easy
F	Firm
H	Hard
VH	Very Hard

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

Samples/Tests

D	Disturbed
U	Undisturbed
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test

EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

MATERIAL DESCRIPTION - SOIL

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

Moisture Condition

D	Dry, looks and feels dry
M	Moist, No free water on remoulding
W	Wet, free water on remoulding

Consistency - In accordance with AS 1726-1993, Appendix A2.5

VS	Very Soft	< 25kPa
S	Soft	25 - 50kPa
F	Firm	50 - 100kPa
St	Stiff	100 - 200kPa
VSt	Very Stiff	200 - 400kPa
H	Hard	≥ 400kPa

Strength figures quoted are the approximate range of Unconfined Compressive Strength for each class.

Density Index. (%) is estimated or is based on SPT results. Approximate N Value correlation is shown in right column.

VL	Very Loose	< 15%	0 - 4
L	Loose	15 - 35%	4 - 10
MD	Medium Dense	35 - 65%	10 - 30
D	Dense	65 - 85%	30 - 50
VD	Very Dense	> 85%	> 50

MATERIAL DESCRIPTION -ROCK

Material Description

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

Core Loss

Is shown at the bottom of the run unless otherwise indicated.

Bedding

Description	Spacing (mm)
Thinly Laminated	< 6
Laminated	6 - 20
Very Thinly Bedded	20 - 60
Thinly Bedded	60 - 200
Medium Bedded	200 - 600
Thickly Bedded	600 - 2000
Very Thickly Bedded	> 2000

Weathering - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

Fresh (F)	Rock substance unaffected by weathering
Slightly Weathered (SW)	Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable.
Moderately Weathered (MW)	Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable.
Highly Weathered (HW)	Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained.
Extremely Weathered (EW)	Rock texture evident but material has soil properties and can be remoulded.

Strength - The following terms are used to described rock strength:

Rock Strength Class	Abbreviation	Point Load Strength Index, Is(50) (MPa)
Extremely Low	EL	< 0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	≥ 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

- ° Diametral Point Load Test
- • Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

MATERIALS STRUCTURE/FRACTURES

ROCK

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

Defects	————	Defects open in-situ or clay sealed
	- - - - - - -	Defects closed in-situ
	.....	Breaks through rock substance

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Type	BP	Bedding Parting
	JT	Joint
	SM	Seam
	FZ	Fracture Zone
	SZ	Shear Zone
	VN	Vein
	FL	Foliation
	CL	Cleavage
	DL	Drill Lift
	HB	Handling break
	DB	Drilling break

Orientation - angle relative to the plane normal to the core axis.

Infilling	CN	Clean
	X	Carbonaceous
	Clay	Clay
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
	MS	Secondary Mineral
	MU	Unidentified Mineral
Shape	PR	Planar
	CU	Curved
	UN	Undulose
	ST	Stepped
	IR	Irregular
	DIS	Discontinuous
Roughness	POL	Polished
	SL	Slickensided
	S	Smooth
	RF	Rough
	VR	Very Rough

SOIL

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.