Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

REPORT
on
GEOTECHNICAL INVESTIGATION

EPPING PARK
61 MOBBS LANE
EPPING

Prepared for
SYDNEY BROADCASTING PROPERTY PTY LTD

Project 45925
March 2009

Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
on
GEOTECHNICAL INVESTIGATION

EPPING PARK
61 MOBBS LANE
EPPING

Prepared for
SYDNEY BROADCASTING PROPERTY PTY LTD

Project 45925
March 2009

Douglas Partners Pty Ltd
ABN 75 053 980 117

96 Hermitage Road
West Ryde NSW 2114
Australia

PO Box 472
West Ryde NSW 1685

Phone (02) 9809 0666
Fax (02) 9809 4095
sydney@douglaspartners.com.au

Douglas Partners
Geotechnics · Environment · Groundwater

TABLE OF CONTENTS

Page

1. INTRODUCTION 1

2. SITE DESCRIPTION 2

3. REGIONAL GEOLOGY 2

4. FIELD WORK 3

   4.1 Methods 3
   4.2 Results 4

5. LABORATORY TESTING 6

   5.1 Soil Samples 6
   5.2 Rock Samples 8

6. INFERRED GEOTECHNICAL MODEL 8

7. COMMENTS 9

   7.1 Proposed Development 9
   7.2 Site Preparation 10
   7.3 Excavation 11
      7.3.1 General 11
      7.3.2 Potential Instability 12
   7.4 Excavation Support 12
      7.4.1 General 12
      7.4.2 Earth pressures 13
      7.4.3 Pressures from Rock Wedges 14
      7.4.4 Ground Anchors 14
   7.5 Groundwater 16
   7.6 Foundations for Lightly Loaded Structures 17
   7.7 Foundations for Heavily Loaded Structures 18
      7.7.1 Spread Footings 18
      7.7.2 Piles 18
   7.8 Pavements 19
   7.9 Soil Aggressivity, Salinity and Acid Sulphate Soils 19

8. FURTHER INVESTIGATION AND CONSTRUCTION INSPECTIONS 20

APPENDIX A Drawings 1 to 7

APPENDIX B Notes Relating to this Report
Borehole Logs

APPENDIX C Laboratory Test Results

PMO
Project 45925
4 March 2009

REPORT ON GEOTECHNICAL INVESTIGATION
EPPING PARK
61 MOBBS LANE, EPPING

1. INTRODUCTION

This report outlines the results of a geotechnical investigation undertaken for the proposed 'Epping Park' residential development at 61 Mobbs Lane, Epping. The work was commissioned by Sydney Broadcasting Property Pty Ltd, owners of the site.

The project involves the redevelopment of the Channel 7 television broadcasting facility which will include the construction of up to 650 residential dwellings. Numerous buildings are proposed which will vary from six storey unit buildings with two basement levels to two storey townhouses constructed at grade. The development will also include associated infrastructure such as roads, footpaths, recreational facilities and over three hectares of public open space. All existing buildings are to be demolished as part of the development.

Geotechnical investigation was undertaken to provide information on the expected subsurface conditions on the site and included drilling test bores at accessible locations, installing groundwater monitoring wells, laboratory testing and engineering analysis. Details of the field work and comments relevant to design and construction are given in this report.

Contamination assessment and waste classification were not in the scope of the current investigation.

2. SITE DESCRIPTION

The development site is approximately rectangular and about 8.9 ha in area. It is bounded by a TAFE college, plant nursery and residential houses to the north, residential houses to the east, Mobbs Lane to the south, and a passive recreational area and creek to the west. A former quarry is located immediately to the south of Mobbs Lane which is currently being redeveloped for residential housing.

The natural ground surface slopes from east to west with an overall fall of some 30 m across the site. The higher, eastern section of the site is relatively flat. The natural surface tends to dip in a westerly direction at grades in the order of 8% to 10%. Some steeper, apparently man-made batters with grades in the order of 20% are also present on the site.

At the time of the investigation numerous buildings, road pavements and vehicle parking areas were located on the eastern and central portions of the site which had been constructed on level platforms during the original and subsequent developments on the site. Satellite dishes and associated buildings were located near the south-western corner of the site.

3. REGIONAL GEOLOGY

Reference to the Sydney 1:100 000 Geological Series Sheet indicates that the eastern portion of the site is underlain by Bringelly Shale which typically comprises shale, carbonaceous claystone, laminite, fine to medium grained lithic sandstone and rare coal. The western portion of the site is shown as being underlain by Ashfield Shale which generally comprises black to dark grey shale and laminite. Both geological units weather to form clay soils of medium to high plasticity.

4. FIELD WORK

4.1 Methods

The field work included twenty-six boreholes drilled at the locations shown on Drawing 1 in Appendix A. The 'original-series' bores (BH1 to BH9, BH11 to BH14, BH16 and BH18 to BH21) were drilled to depths of 5.95 m to 13.27 m using a truck-mounted Edson 3000 drilling rig. Bores BH10, BH15 and BH17 were not drilled due to access restrictions at the time of the field work.

The original-series bores were commenced using solid flight augers to drill through the overburden materials until weathered rock was encountered. Standard penetration tests were undertaken at regular depth intervals and disturbed soil samples were also collected from the tip of the auger. These bores were then cased and advanced using NMLC sized diamond core drilling equipment to obtain 50 mm diameter samples of the rock for identification and strength testing purposes.

The '100-series' bores (BH101 to BH108) were drilled to depths of 1.4 m to 7.2 m using the same drilling rig. Solid flight augers were used to drill through the overburden materials until weathered rock was encountered. Soil samples were collected regularly from the tip of the auger.

Groundwater monitoring wells were installed in bores BH1, BH5, BH13 and BH21 at the completion of the drilling programme to allow groundwater depth measurements to be made over time.

The ground surface levels at the bores were measured to Australian Height Datum (AHD) using information obtained from a survey plan provided by the client.

4.2 Results

The subsurface conditions encountered in the test bores are presented in the borehole logs in Appendix B, together with notes defining descriptive terms and classification methods.

The bores encountered:

- **TOPSOIL AND/OR FILLING –** sandy, silty and clayey topsoil with rootlets to depths of 0.1 m to 0.25 m in several bores. Clay, gravelly clay, gravelly silty clay, sandy gravel and sandy clay filling to depths of 0.2 m to 4.6 m. Filling depths of greater than 1.5 m were encountered in the central portion of the site in areas that had obviously been regraded as part of the previous development of the site.
- **RESIDUAL SOIL –** clay, silty clay and shaly clay with ironstone bands and gravel to depths of 1.15 m to 7.2 m. The residual soil was generally of stiff, very stiff and hard consistency.
- **WEATHERED ROCK –** the cored bores generally encountered laminite bedrock (thinly interbedded sandstone and siltstone) with some zones of siltstone and shale. The rock was typically extremely low to low strength to depths of 3.5 m to 12.1 m, generally becoming medium or high strength to the base of the bores at 5.95 m to 13.27 m depth. Consistent medium strength or stronger rock was not encountered in bores BH13, BH16, BH19 or BH21.

There were several zones of core loss evident in the cored bores. It is likely that this core loss was due to weaker, friable or fragmented bands in the rock strata.

Tables 1A to 1C summarise the levels at which different materials were encountered in the bores. The rock has been classified in accordance with Pells et al (1998) which classifies rock depending on strength, fracturing and defects within the profile. Class V rock is typically weathered, very low strength, fractured rock while Class I is typically fresh, high strength, unbroken rock.

Table 1A – Summary of Material Strata Levels and Rock Classifications

Material Strata	RL of Top of Material Strata (AHD)								
	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9
Ground Surface	93.2	95.0	94.7	96.1	100.5	101.8	101.2	99.4	102.0
Residual Soil	92.8	94.9	94.5	91.8	99.7	100.2	99.7	94.8	101.9
Class V/IV[1] Rock	88.8	93.4	92.6	89.4	97.3	99.0	97.7	92.9	100.0
Class III[1] Rock	87.3	91.4	90.1	88.4	95.5	94.9	94.2	91.2	95.2
Base of Borehole	84.2	86.0	88.4	87.5	94.4	93.3	92.2	90.0	93.2
Ground-Water[2]	93.0	-	-	-	96.4	-	-	-	-

Notes: [1] Refer to Pells et al (1998) for rock class descriptions
[2] Groundwater measured 31 to 37 days after drilling

Table 1B – Summary of Material Strata Levels and Rock Classifications

Material Strata	RL of Top of Material Strata (AHD)								
	BH11	BH12	BH13	BH14	BH16	BH18	BH19	BH20	BH21
Ground Surface	110.0	111.6	115.0	110.7	114.0	115.0	115.6	104.3	116.2
Residual Soil	109.4	109.7	114.8	106.7	113.8	113.8	115.4	104.1	115.7
Class V/IV[1] Rock	107.9	108.5	113.8	103.5	112.3	113.3	114.5	103.1	114.7
Class III[1] Rock	102.0	107.2	-	99.9	-	102.9	-	100.8	-
Base of Borehole	100.8	102.8	106.2	99.3	105.5	101.8	108.4	98.4	109.0
Ground-Water[2]	-	-	109.1	-	-	-	-	-	<109.0

Notes: [1] Refer to Pells et al (1998) for rock class descriptions
[2] Groundwater measured 31 to 37 days after drilling

Table 1C – Summary of Material Strata Levels

Material Strata	RL of Top of Material Strata (AHD)							
	BH101	BH102	BH103	BH104	BH105	BH106	BH107	BH108
Ground Surface	86.3	85.8	87.2	97.2	112.9	114.9	115.7	116.3
Residual Soil	86.1	85.6	87.0	97.0	112.7	114.7	115.5	115.9
Hard Shaly Clay	81.6	79.3	83.2	96.1	111.6	-	-	114.7
Base of Borehole	81.3	78.6	82.7	95.8	111.4	111.8	113.9	114.4

The core samples exhibited numerous joints dipping in the 40^o to 60^o range (and steeper) which is fairly typical of the Bringelly and Ashfield Shales. Several joints were assessed as being smooth-sided and some clay-filled.

Free groundwater was not observed during augering, and the use of drilling fluid prevented groundwater observation during coring. The groundwater monitoring wells were bailed to remove water 31 to 37 days after the completion of drilling. The groundwater levels were allowed to stabilise and were measured at depths of 0.2 m (RL 93.0), 4.1 m (RL 96.4) and 5.9 m (RL 109.1) in BH1, BH5 and BH13 respectively. The monitoring well in BH21 was dry to a depth of 7.2 m (RL 109.0).

5. LABORATORY TESTING

5.1 Soil Samples

Selected soil samples were tested for a range of physical and chemical properties including plasticity, linear shrinkage, dispersion potential, California bearing ratio, sulphate and chloride ion content, electrical conductivity and pH. A summary of the results is provided in Table 2 and Table 3.

Table 2 – Summary of Physical Test Results on Soil Samples

Bore Location	Depth (m)	Description	W_L (%)	PI (%)	LS (%)	Emerson (Class)	CBR (%)	Swell (%)
BH1	1.0	Clay	84	46	20	-	-	-
BH2	0.5	Clay	-	-	-	4	-	-
BH5	1.0	Clay	-	-	-	2	-	-
BH8	2.8-3.25	Clay filling	33	14	9	-	-	-
BH11	1.0	Clay	-	-	-	4	-	-
BH12	1.0	Clay filling	29	9	5.5	-	-	-
BH18	1.0	Clay filling	52	27	14	-	-	-
BH21	0.5	Clay	-	-	-	4	-	-
BH101	1.0	Clay	29	12	6.5	-	-	-
BH101	1.0-2.2	Clay	-	-	-	-	7	1.1
BH102	1.1-2.4	Clay	-	-	-	-	7	0.9
BH104	0.5	Clay	60	32	15.5	-	-	-
BH104	0.3-0.9	Clay	-	-	-	-	4	2.2
BH105	0.2-1.2	Clay	-	-	-	-	4.5	2.0
BH106	0.7-1.7	Clay	-	-	-	-	3	1.8
BH107	1.0	Clay	72	43	19	-	-	-
BH108	0.5	Clay	70	41	16.5	-	-	-
BH108	0.7-1.6	Clay	-	-	-	-	1.5	5.1

Notes: W_L = Liquid limit; PI = Plasticity index; LS = Linear shrinkage; CBR = California bearing ratio (4 day soak, 4.5 kg surcharge)

Table 3 – Summary of Chemical Test Results on Soil Samples

Bore Location	Depth (m)	Description	SO_4^{2-} (mg/kg)	Cl^- (mg/kg)	EC (µS/cm)	pH (pH units)
BH3	0.5	Clay	150	<100	80	4.7
BH8	1.0	Clay filling	59	<100	42	5.1
BH13	0.5	Clay	35	110	77	4.6
BH19	1.0	Clay	27	<100	50	4.8

Notes: SO_4^{2-} = Sulphate ion; Cl^- = Chloride ion; EC = Electrical conductivity

The comprehensive laboratory result sheets are included in Appendix C.

5.2 Rock Samples

Eighty-five selected samples of the better quality rock core were tested for axial point load strength index (Is_{50}). The results ranged from 0.1 MPa to 2.1 MPa which corresponds to very low to low strength and high strength rock respectively. These Is_{50} results suggest an unconfined compressive strength (UCS) in excess of 40 MPa for the high strength rock encountered during the investigation.

6. INFERRED GEOTECHNICAL MODEL

The site appears to be underlain by varying depths of filling, residual soil, then generally laminite bedrock with some zones of siltstone and shale. Filling was encountered to a greater depth in the central portion of the site (up to 4.6 m deep) and this filling is possibly the result of cut-to-fill earthworks activities that were undertaken during previous development works on the site. The filling generally comprised clayey soils with ironstone gravel inclusions.

The residual soil comprised clayey soils formed from weathering of the underlying parent rock. The strength of the soils was generally stiff to hard. The Atterberg limits indicate that the soils are moderately to highly reactive to changes in moisture content. The dispersion testing indicates the soils are moderately to highly dispersive. The CBR results indicate that the soils lose strength and swell upon saturation. One sample (from BH108 at 0.7 – 1.6 m depth) experienced excessive swelling and strength reduction.

Bedrock was encountered below depths of 1.15 m to 6.55 m across the site. The north-eastern portion of the site was underlain by a deeply weathered laminite profile (in the order of 3.5 m to 10 m of extremely to moderately weathered laminite) and is inferred to be of the Bringelly Shale geological unit. The south-western portion of the site is underlain by a shallower weathered laminite profile (in the order of 1.0 m to 2.5 m of extremely to moderately weathered laminite) and is inferred to be of the Ashfield Shale geological unit. The weathered profile was generally underlain by slightly weathered to fresh, medium and/or high strength bedrock apart from several bores near the eastern boundary that had a deeply weathered profile throughout.

Numerous 45^{o} and steeper joints were evident in the core samples which are typical within the shale units in the Sydney basin. Unconfined compressive rock strengths in excess of 40 MPa were inferred from the point load strength index testing.

Groundwater was encountered at depths of 5.9 m (RL 109.1) in BH13 and was greater than 7.2 m depth (below RL 109.0) in BH21 which are in the Bringelly Shale zone of the site. Groundwater was encountered at a depth of 4.1 m (RL 96.4) in BH5 which is near the inferred transition of the Bringelly Shale and Ashfield Shale units, and at a depth of 0.2 m (RL 93.0) in BH1 which is in the Ashfield Shale zone of the site.

These observations suggest that the groundwater is deepest in the more highly weathered Bringelly Shale which is expected due to the higher permeability of weathered rock compared to fresh material. The groundwater was close to artesian in the lower section of the site which is probably due to the relatively low permeability of the fresher rock forcing seepage and groundwater that flows in a westerly direction from the upper portion of the site to flow out of the slope.

A contour plan showing the inferred levels of the top of the weathered Class V rock is included as Drawing 2 in Appendix A. A contour plan showing the inferred levels of the top of the fresher Class III rock is included as Drawing 3. Drawing 4 shows the inferred boundary between the Bringelly Shale and Ashfield Shale geological units.

7. COMMENTS

7.1 Proposed Development

The project involves the redevelopment of the Channel 7 television broadcasting facility which will include the construction of up to 650 residential dwellings. Numerous buildings are proposed which will vary from six storey unit buildings with two basement levels to two storey townhouses constructed at grade. The development will also include associated infrastructure such as roads, footpaths, recreational facilities and over three hectares of public open space. All existing buildings are to be demolished as part of the development.

Based on the size of the proposed buildings the column loads for the larger structures are expected to be in the order of 3000 kN to 5000 kN, and possibly higher if wide column spacings are used. The proposed bulk excavation levels for the basements are yet to be finalised.

The geotechnical issues considered relevant to the proposed development are site preparation, excavation, excavation support, groundwater, foundations, and pavements. Comments are also provided on soil aggressivity, salinity and acid sulphate soils.

7.2 Site Preparation

Areas on the site that are to be filled to support structures, pavements and services should be stripped of vegetation and organic topsoil. The exposed subgrade should be proof-rolled in the presence of an experienced geotechnical professional using a minimum 12 tonne pad-foot or steel smooth drum roller. Any areas on the site exhibiting excessive deflection should be excavated and replaced with suitable granular material compacted in layers. Specific remediation advice can be provided on site once the subgrade has been inspected.

Any filling required on the site should be placed in layers not exceeding a loose thickness of 250 mm and compacted to a dry density ratio of between 98% and 102% relative to Standard compaction. If the filling exhibits clay-like properties it should be prepared within 2% of the Standard optimum moisture content.

The soil and weathered rock on the development site should be suitable for reuse from a geotechnical perspective providing all deleterious material (e.g. particles greater than 150 mm diameter, organic material, waste etc.) is removed from the filling prior to compaction.

The Atterberg limit and linear shrinkage test results indicate the soils on the site are moderately to highly reactive to changes in moisture content and it is therefore important to place this material as close to optimum moisture as possible to reduce the potential of significant shrink/swell movements. The dispersion testing indicates that the soil is moderately to highly dispersive and it will therefore be necessary to provide relatively flat batters and vegetation for both cut and fill slopes. Maximum permanent, vegetated batter slopes of 3(H):1(V) are suggested for the residual soils encountered on the site.

Consideration should be given to placing a 150 mm thick layer of granular material (e.g. recycled crushed concrete or ripped sandstone) as the top layer of unformed roads using during construction in order to provide a trafficable surface that will be less prone to disturbance from construction machinery and wet weather.

Filling compacted in accordance with this report may experience long-term settlements of 0.5% to 1% of the filling depth. This is in addition to settlement caused by the application of loads on the surface of the filling.

Australian Standard AS 3798 – 2007 *Guidelines on earthworks for commercial and residential developments* provides guidance as to appropriate testing frequencies for the testing of filling. It is recommended that all filling in areas that will support buildings and pavements be undertaken with Level 1 responsibility.

7.3 Excavation

7.3.1 General

Excavation for the basement levels is expected to be required in filling, residual soil and rock of varying strength up to high strength (depending on the design bulk excavation levels). Excavation in filling, soil and extremely low to very low strength rock should be readily achievable using conventional earthmoving equipment such as a hydraulic excavator with bucket attachment.

Excavation in low strength and stronger rock will require the use of heavy ripping equipment such as a Caterpillar D8 dozer or bigger, hydraulic rock hammers, milling heads and/or rock saws. The high strength laminite will require very large hammers and low productivity can be expected. Potential excavation contractors should be made aware that rock in excess of 40 MPa UCS was encountered on the site.

The use of such large equipment will cause vibrations. The relative remoteness of the proposed basement excavations suggests vibrations are unlikely to significantly affect structures on neighbouring properties.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (DECC, 2008).

7.3.2 Potential Instability

Landslip instability sometimes occurs on southward sloping sites that are situated near boundaries of the Bringelly and Ashfield Shales. Examples of such landslips can be seen along the ridgelines in the Carlingford, West Pennant Hills and Castle Hill areas of north-western Sydney. A major contributing factor to landslips in these areas is artesian groundwater pressure acting on a soil and/or rock mass which encourages slope movement and ultimately slippage.

Although there was little evidence of landslip occurrence during an inspection on the development site, the artesian groundwater conditions in the lower areas indicate that some movement is possible particularly during excavation activities. It will therefore be necessary to batter all unsupported excavations in accordance with the recommendations provided in Section 7.4 of this report and to also inspect major excavations to check for potential instability and excessive groundwater ingress.

There is also the potential for rock wedge failures in excavation faces caused by adversely oriented joints being exposed during excavation works. Section 7.4 outlines suitable support requirements to reduce the risk of wedge failures.

7.4 Excavation Support

7.4.1 General

Vertical excavations in filling, soil and weathered rock are not expected to be self-supporting for any extended period of time. Temporary batters may be feasible on the site in areas of shallow excavation or where space permits batters in deeper excavations. A maximum temporary batter slope of 1(H):1(V) is recommended for cuts up to 3 m in height in the clay soils and weathered rock encountered on the site. A maximum temporary batter slope of 1.5(H):1(V) is recommended for cuts up to 6 m in height in the same materials.

Shoring support will be required in areas where batters are considered impractical. Soldier piles with infill reinforced shotcrete panels are commonly used to support excavations in Ashfield and Bringelly Shale. The soldier piles would generally be spaced at about 2 – 2.5 m centres and should be founded at least 1 m below bulk excavation level. Shotcreting will be needed to the full excavation depth and should be undertaken in about 2.5 m drops as excavation proceeds in order to reduce the risk of local slippages. Temporary ground anchors will probably be required to prevent excessive lateral deformation.

7.4.2 Earth pressures

Excavations braced either temporarily or permanently will be subjected to earth pressures from the ground surface down to the top of Class III rock. Additional loads from rock wedges may also be applied to the wall and need to be considered in the design.

Suitable design parameters for shoring systems are shown in Table 4. Allowance for hydrostatic pressures, sloping ground surfaces and surcharge loads should also be made where applicable.

Table 4 – Design Active Earth Pressures and Bulk Unit Weights

Material	Temporary Active (K_a)	Permanent Active (K_a)	Bulk Unit Weight (kN/m^3)
Filling & Residual Soil	0.3	0.4	20
Class V/IV Laminite	0.2	0.25	22
Class III Laminite	0	0	23

Passive pressure can be used to provide lateral support for piles installed below the bulk excavation level. Table 5 outlines ultimate passive pressure values for piles founded in various materials.

Table 5 – Ultimate Passive Earth Pressures

Material	Ultimate Passive Pressure* (kPa)
Class V/IV Laminite	1000
Class III Laminite	3000

* Only applicable below bulk excavation level

The depth equal to at least one pile diameter below the base of the excavation should be ignored in passive pressure calculations, and the rock will need to be inspected by an experienced geotechnical professional to check for unfavourable jointing. The presence of unfavourable joints may result in additional anchors needing to be installed to provide lateral support at the toe of the piles.

To determine the loads acting on a wall with more than one row of support, it is suggested that a trapezoidal type pressure distribution be adopted. Typical lateral pressure distributions for preliminary design for various conditions are shown in Drawings 5 – 7 in Appendix A. The design of multi-anchored walls should also allow for 45° joints as discussed in the following section. Inspections of the rock during excavation may also indicate additional support is required on some parts of the site.

7.4.3 Pressures from Rock Wedges

The design of temporary and permanent support will need to consider the possibility that 45° joints in the laminite will daylight near the base of the excavation leading to large wedges of rock requiring support by the temporary and permanent retaining structures. Sufficient anchoring of the shoring wall should be undertaken to prevent movements along 45° joints, even though there is a low probability that a joint would run the full length and height of the excavation.

It is suggested that preliminary design be carried out such that the support system has a factor of safety of 1.1 against sliding along the most unfavourable 45° joint. The support system would typically comprise anchors spaced over the rock face. These anchors should have their bond lengths behind the projected 45° line from the bulk excavation level and should provide sufficient force to resist the movement of a wedge of rock projected at 45° from just below the anchor to the ground surface. The frictional resistance of the wedge along the joint may be calculated assuming an angle of friction of 20°. Additional anchors may be required to increase the factor of safety if large wedges are observed during excavation.

7.4.4 Ground Anchors

Where necessary, the use of inclined tie-back (ground) anchors is suggested for the lateral restraint of the perimeter piled wall system. Such ground anchors should be inclined below the horizontal to allow anchorage into the stronger bedrock materials at depth. The design of

temporary ground anchors for the support of piled wall systems may be carried out using the allowable average bond stresses at the grout-rock interface given in Table 6.

Table 6 – Bond Stresses for Anchor Design

Material Description	Maximum Allowable Average Bond Stress (kPa)
Class V/IV Laminite	100
Class III Laminite	250

Ground anchors should be designed to have a free length equal to their height above the base of the excavation and minimum 3 m bond length. After installation they should be proof loaded to 125% of the design working load and locked-off at no higher than 60% of the working load. Periodic checks should be carried out during the construction phase to ensure that the lock-off load is maintained and not lost due to creep effects or other causes.

The parameters given above assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good anchoring practice. Careful installation and close supervision by a geotechnical specialist may allow increased bond stresses to be adopted during construction, subject to testing.

In normal circumstances the building will restrain the basement excavation over the long term and therefore ground anchors are expected to be temporary only. The use of permanent anchors would generally require careful attention to corrosion protection. Further advice on design and specification should be sought if permanent anchors are to be employed at this site.

It will be necessary to obtain permission from neighbouring landowners prior to installing anchors that will extend beyond the perimeter of the site. In addition, care should be taken to avoid damaging buried services and pipes during anchor installation.

7.5 Groundwater

Groundwater in the upper section of the site was encountered below depths of about 6 m. Seepage into basement excavations in this area of the site is expected to be able to be controlled by installing an appropriate drainage system behind the basement walls and by collecting seepage in a sump pit in the lowest basement level. A pump will probably be required to remove water from the sump unless a gravity drainage system can be installed.

Groundwater in the lower section of the site was close to artesian and would be expected to be artesian during and following periods of rainfall. The rate of groundwater inflow will be governed by the degree of fracturing and jointing in the rock mass and the pressure head at the location of the basement. Seepage can probably be controlled using a basement drainage system although it should be noted that constant water inflow is expected. A gravity discharge system would reduce reliance on pumps if such a system is possible.

Consideration should also be given to installing drainage trenches on the upslope sides of the basement excavations in the lower sections of the site. These drainage trenches should be constructed to intercept groundwater flow within the weathered soil and rock profile and discharge the water around the basement area. This procedure should reduce the volume of water ingress to the basement levels.

Seepage through the Bringelly and Ashfield Shales sometimes contains soluble iron complexes which have the potential to block drainage material and additional precautions (e.g. wash-out points etc.) may need to be taken to avoid blocking the drains in the medium to longer term.

A pump will probably be required to periodically remove stored water from the basement excavations during construction. A pump may also be needed to remove seepage from bored pile excavations prior to the placement of concrete, if bored piles are used for shoring support. A tremie may be required to construct bored piles in the lower sections of the site if pumping does not remove a sufficient volume of water.

7.6 Foundations for Lightly Loaded Structures

Lightly loaded structures on the upper, flatter areas of the site could be supported on spread footings founded in controlled filling, residual soil or weathered rock. The Atterberg limit and linear shrinkage test results indicate that the clay soils are moderately to highly reactive to changes in moisture content. If footings are to be designed in accordance with Australian Standard AS 2870 – 1996 *Residential slabs and footings – Construction,* then it is recommended that the footings of permanent building be designed on the basis of a Class H site.

Alternatively, footings could be designed using the parameters provided in Table 7 providing they are founded at least 0.8 m below the finished ground surface.

Table 7 – Design Parameters for Spread Footings in Lightly Loaded Structures

Material	Maximum Allowable Bearing Pressure (kPa)
Controlled Filling	150
Stiff to Very Stiff Clay	150
Hard Clay	250
Class V/IV Laminite	700

Allowance for some ground movement due to the shrink/swell characteristics of clay soils on the site should be made in the design of all structures. AS 2870 provides guidance as to potential movements in highly reactive soils.

Settlement of a spread footing is dependent on the dimensions of the footing and the load applied. As a guide, a 1 m square pad footing designed using the parameters provided in Table 7 may experience settlement in the order of 10 mm to 15 mm due to the application of the design working load. Differential settlements between footings founded in similar strata are expected to be less than 50% of the value of total settlement.

7.7 Foundations for Heavily Loaded Structures

7.7.1 Spread Footings

The foundation conditions for the heavily loaded structures are expected to vary across the site. The basement excavations are expected to expose either Class V/IV or Class III laminite. Due to the potential for landslip conditions on the site it is recommended that all heavily loaded structures be founded in Class III bedrock. Structures founded in Class V/IV bedrock are at risk of damage if ground movements occur during or after construction.

Spread footings (i.e. pad or strip footings) will only be suitable on the site if Class III bedrock is exposed at or within about 1 m of the bulk excavation level. An allowable bearing pressure of 3500 kPa could be assumed for Class III laminite.

Footings founded in Class III bedrock and designed using the parameters provided in this report would be expected to settle no greater than 0.5% to 1% of the footing width at working load. Differential settlements between footings founded in similar strata are expected to be less than 50% of the value of total settlement.

It will be necessary to pour a blinding layer in the base of the footings to protect the foundation material unless the footings can be poured on the same day they are excavated.

7.7.2 Piles

Bored foundation piles could be designed using the parameters outlined in Table 8. Shoring piles could also be designed to support structural loads from the proposed buildings if founded below excavation level.

Table 8 – Geotechnical Parameters for Bored Piles

Material	Maximum Allowable End-Bearing Pressure (kPa)	Maximum Allowable Shaft Adhesion* (kPa)
Class V/IV Laminite	1000	75
Class III Laminite	3500	300

* Only applicable below bulk excavation level and where adequate socket roughness is achieved

Settlement of piles subjected to vertical loads will vary depending on the loads applied and the foundation conditions below the pile toe. As a guide, piles designed using the parameters outlined in Table 8 can expect settlements of less than a few millimetres under design loads.

7.8 Pavements

The CBR test results indicate that the residual soils on the site experience a loss of strength and significant swelling upon saturation. A subgrade CBR of 3% could be adopted for pavement design purposes although it should be noted that some form of subgrade improvement may be required in areas of the site with particularly poor subgrade strength such as near BH108. Any areas requiring improvement should be able to be delineated during subgrade preparation inspections.

Appropriate cross-fall and subsurface drainage should be installed to reduce the risk of the clayey subgrade becoming saturated during periods of wet weather. Good construction practice, such as installing subsurface drains around the perimeter of any garden or grassed areas, will also help to reduce the chance of subgrade deterioration caused by excessive irrigation.

Pavements in the lower areas of the site may require additional drainage provisions due to the artesian nature of the groundwater in these areas. An allowance for a free-draining granular layer within the pavement profile and additional subsurface drains on the upslope of the pavements should be made.

7.9 Soil Aggressivity, Salinity and Acid Sulphate Soils

Comparison of the test results with the criteria outlined in Australian Standard AS 2159 – 1995 *Piling – Design and installation* indicates that the exposure classification is mild for buried steel and non-aggressive for concrete. Further, the laboratory test results indicate non-saline conditions in the samples tested.

Acid sulphate affected alluvium is generally found in Quaternary-aged alluvial sediment below about RL 10. The soils on the development site are residual in origin and can therefore be assessed as being non-acid sulphate affected.

8. FURTHER INVESTIGATION AND CONSTRUCTION INSPECTIONS

The boreholes at the three inaccessible locations (BH10, BH15 and BH17) could be drilled once access becomes available to refine the inferred geotechnical model and reduce the risk of uncertainties during construction. Further investigation into the artesian characteristics in the lower areas of the site may also be warranted to provide information for the design of basement drainage and diversion systems. Additional analysis and advice may also be required once the development plans have been finalised and the basement levels of each building have been determined.

Construction inspections should be undertaken by an experienced geotechnical professional at the following milestones:

- During proof-rolling of filling and pavement subgrade areas;
- During and following excavation to inspect rock faces and batter slopes;
- During stressing of ground anchors;
- During excavation of spread footings to check the suitability of the foundation material; and
- During shoring and foundation pile installation to check the suitability of the foundation material, base cleanliness and socket roughness.

DOUGLAS PARTNERS PTY LTD

Reviewed by

Peter Oitmaa
Senior Associate

Michael J Thom
Principal

APPENDIX A
Drawings 1 to 7

LEGEND

- AUGERED BORE LOCATION
- CORED BORE LOCATION
- CORED BORE LOCATION (NOT DRILLED)

LOCALITY PLAN

Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Sydney Broadcasting Property Pty Ltd	OFFICE: Sydney	TITLE: Location of Boreholes Epping Park 61 Mobbs Lane EPPING
	PROJECT No: 45925	DRAWN BY: PMO	
	DATE: 20.02.2009 SCALE: As shown	APPROVED BY: RLO.	

DRAWING No: 1
REVISION: A

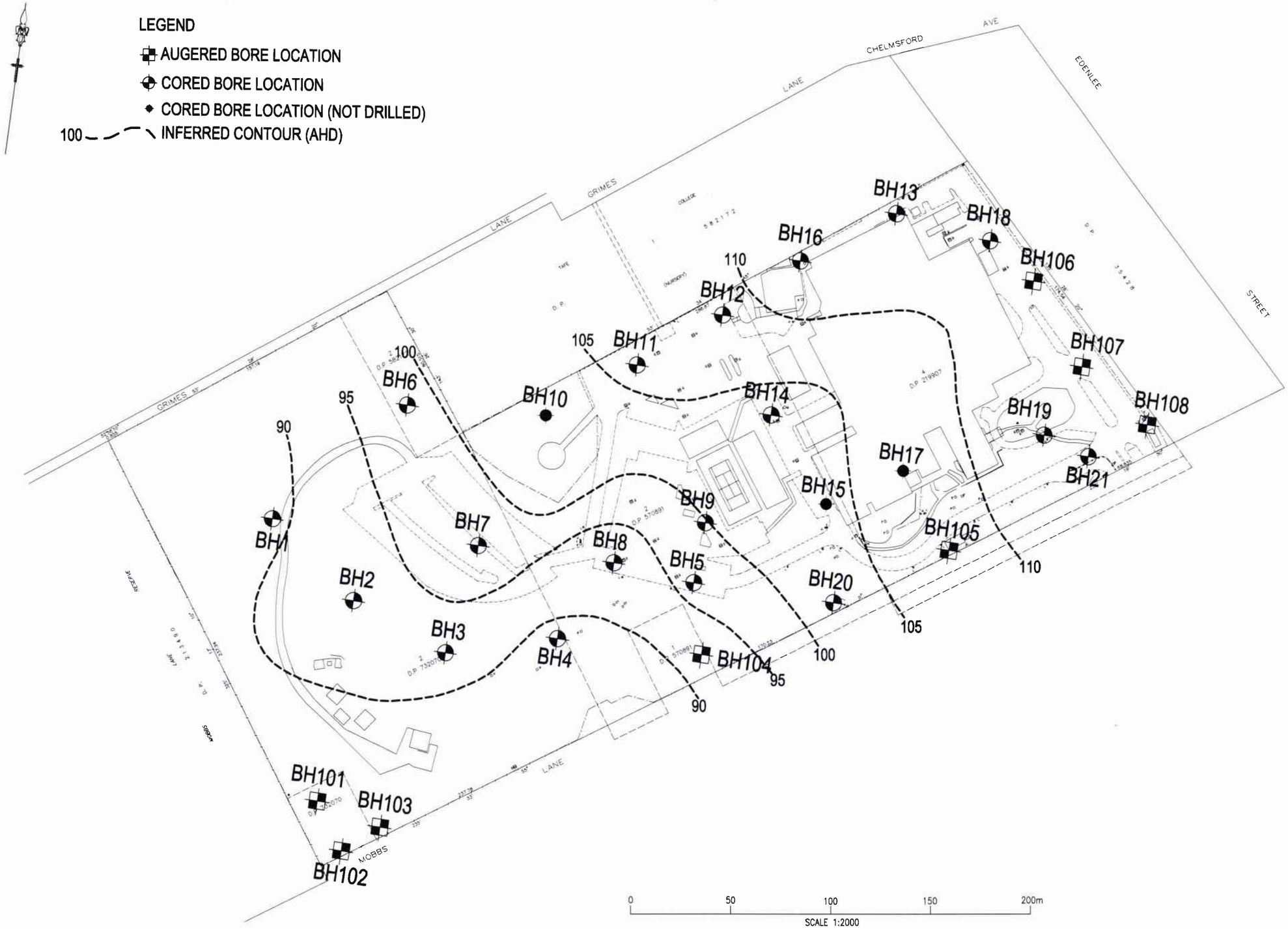
LEGEND

AUGERED BORE LOCATION

CORED BORE LOCATION

CORED BORE LOCATION (NOT DRILLED)

100 INFERRED CONTOUR (AHD)



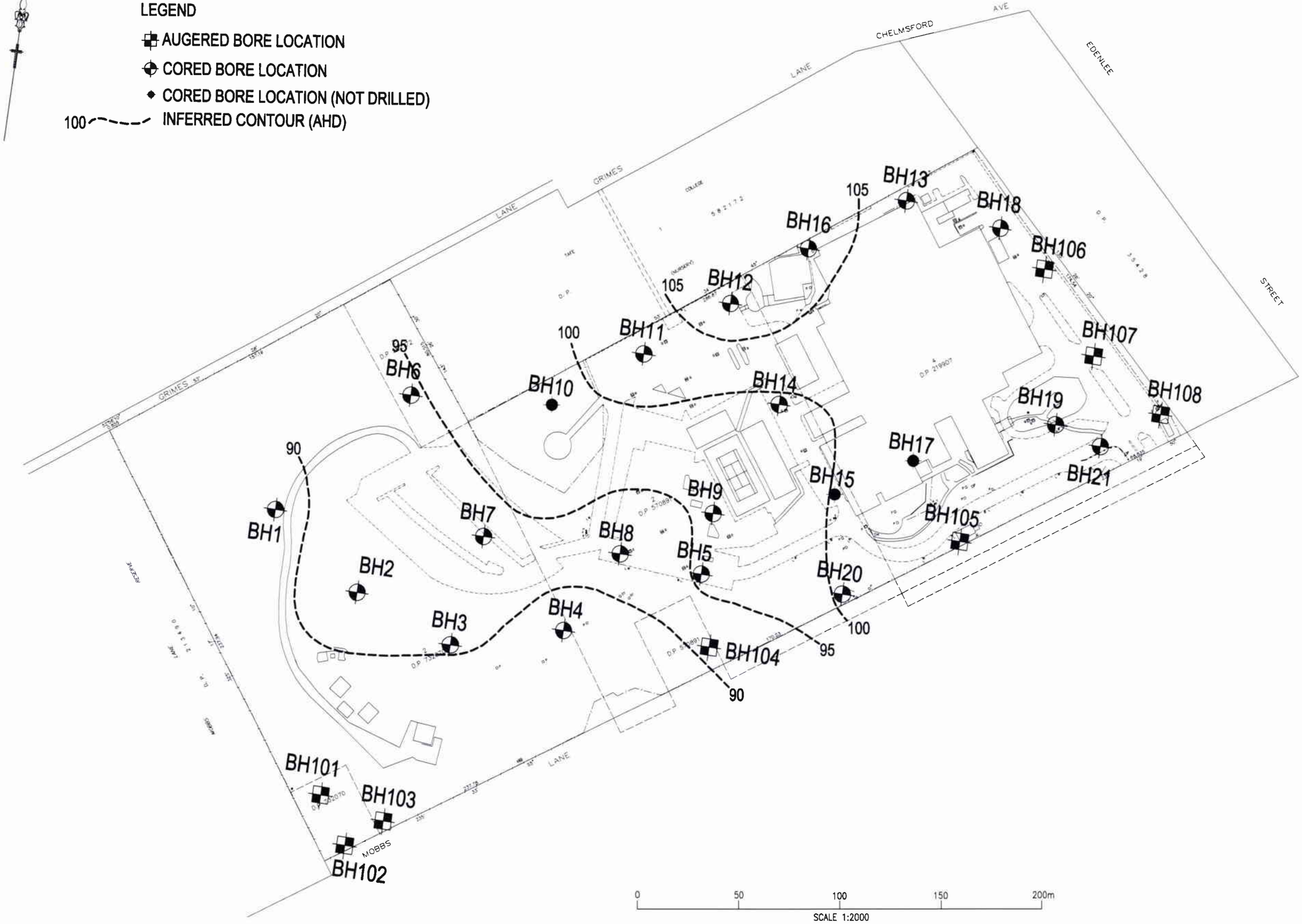
Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Sydney Broadcasting Property Pty Ltd	OFFICE: Sydney	TITLE: Contours Showing Top of Class V Rock Epping Park 61 Mobbs Lane EPPING
	PROJECT No: 45925	DRAWN BY: PMO	
	DATE: 23.02.2009 SCALE: As shown	APPROVED BY:	

DRAWING No: 2

REVISION: A

LEGEND

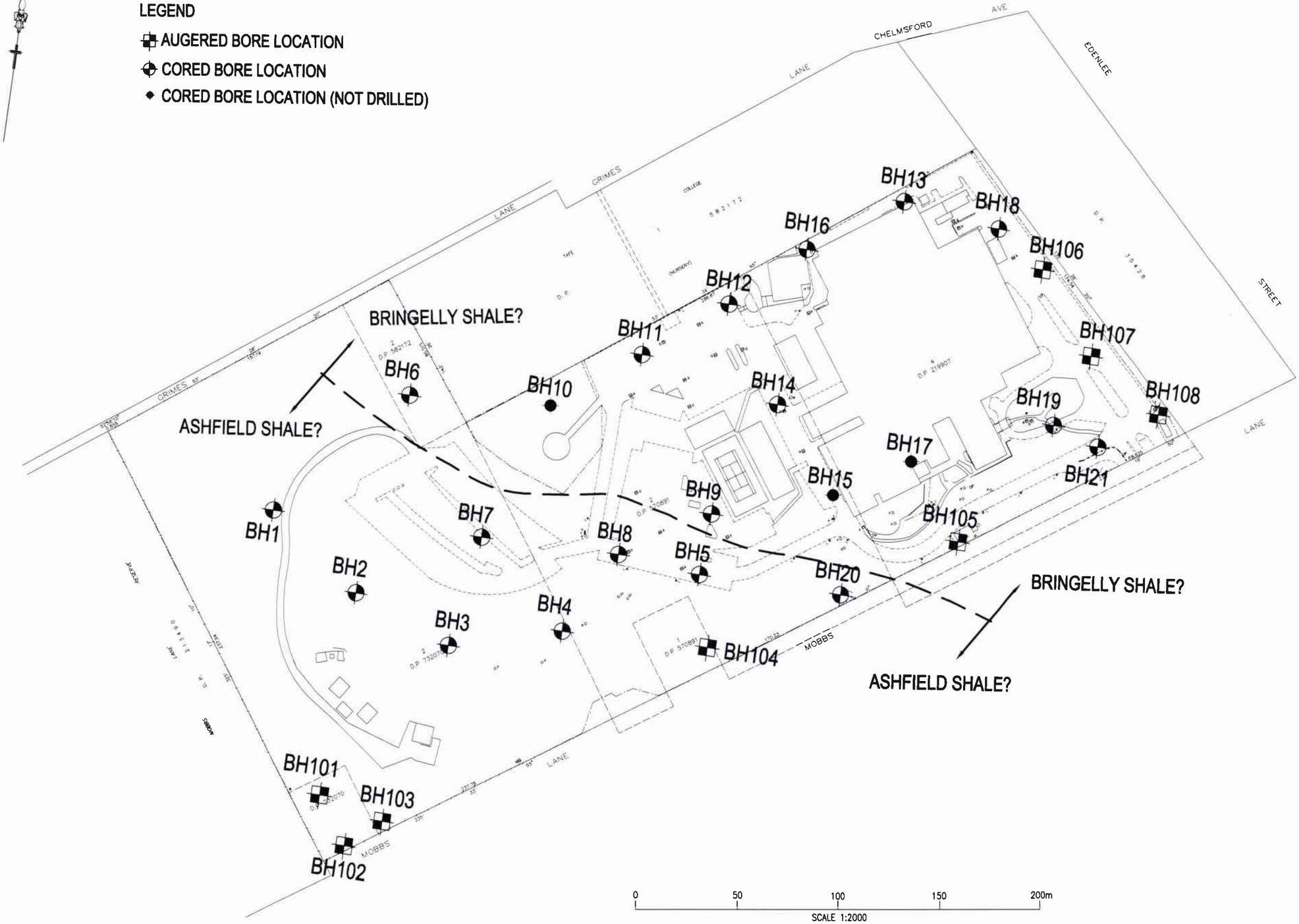
- AUGERED BORE LOCATION
- CORED BORE LOCATION
- CORED BORE LOCATION (NOT DRILLED)
- 100 INFERRED CONTOUR (AHD)



Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Sydney Broadcasting Property Pty Ltd		OFFICE: Sydney	TITLE: Contours Showing Top of Class III Rock Epping Park 61 Mobbs Lane EPPING	DRAWING No: 3 REVISION: A
	PROJECT No: 45925		DRAWN BY: PMO		
	DATE: 23.2.2009	SCALE: As shown	APPROVED BY:		

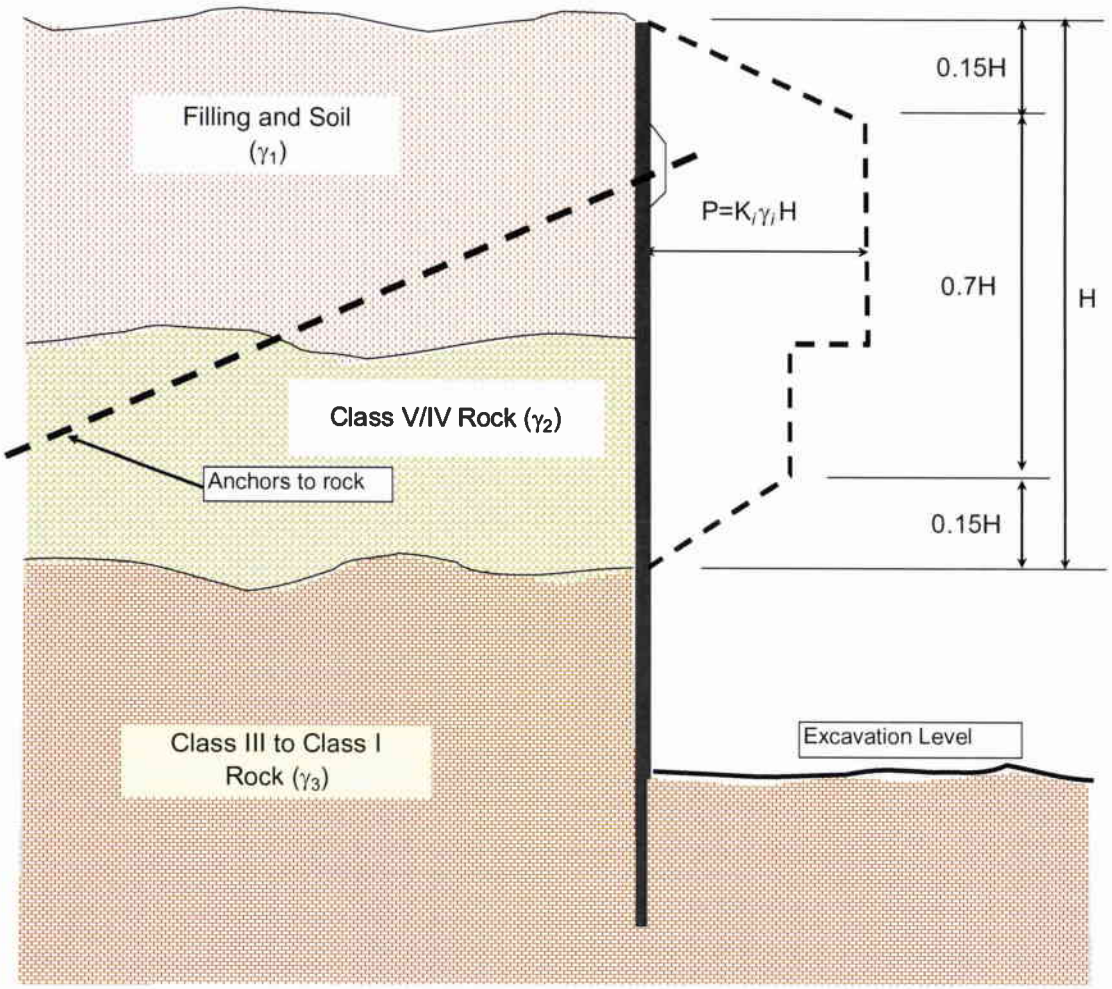
LEGEND

- AUGERED BORE LOCATION
- CORED BORE LOCATION
- CORED BORE LOCATION (NOT DRILLED)



Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Sydney Broadcasting Property Pty Ltd		OFFICE: Sydney	TITLE: Inferred Geological Boundary Epping Park 61 Mobbs Lane EPPING
	PROJECT No: 45925		DRAWN BY: PMO	
	DATE: 23.2.2009	SCALE: As shown	APPROVED BY: RLO.	

DRAWING No: 4
REVISION: A



Notes

P= soil pressure in kPa

H= height of wall above the level of Class III Rock

γ_i = soil unit weight of the *i*th layer (kN/m^3)

H= height of wall above the level of low to medium strength rock

K_i = earth pressure coefficient of the *i*th layer

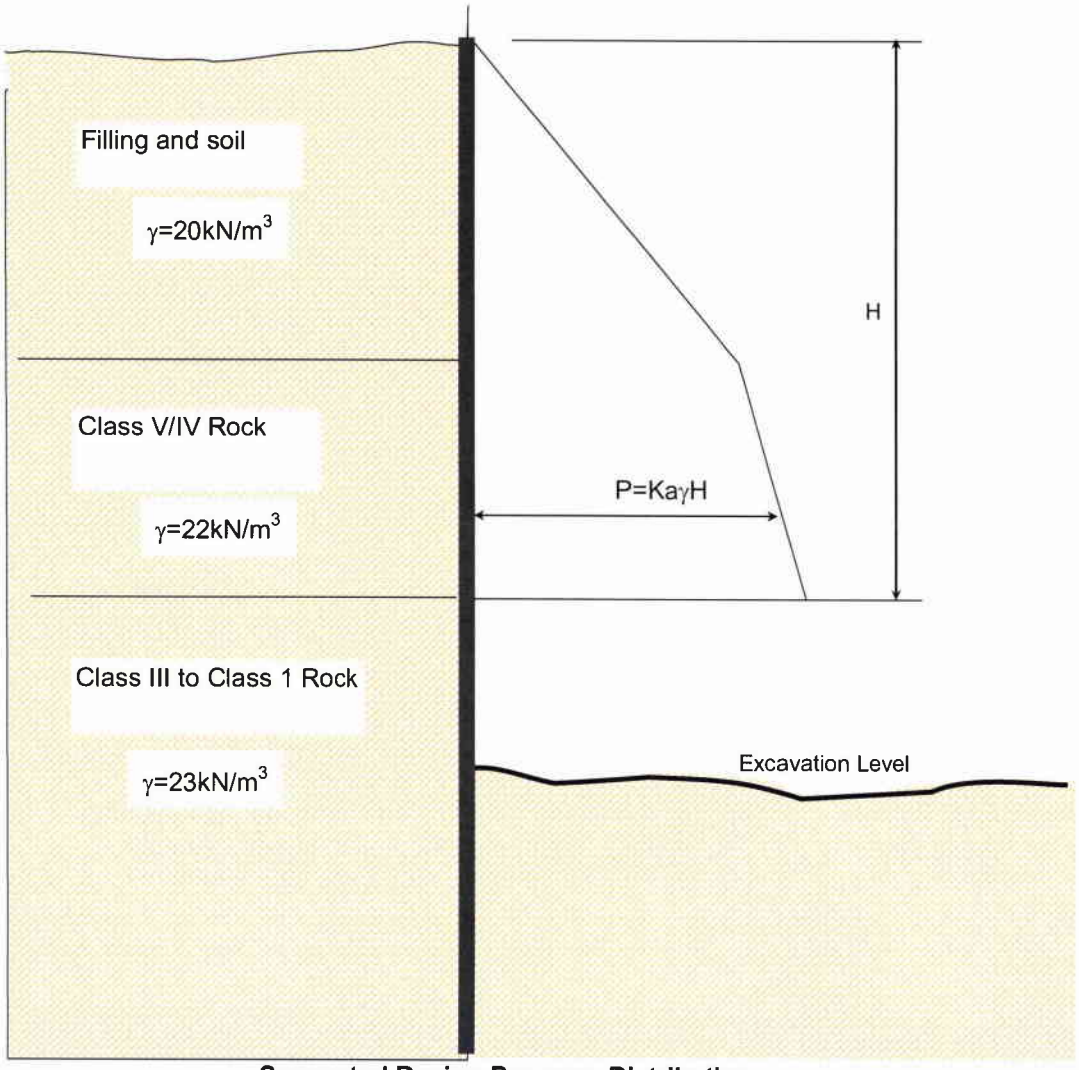
Hydrostatic pressures and surcharge loads in addition to those shown above

Douglas Partners
Geotechnics · Environment · Groundwater

Sydney, Newcastle, Brisbane, Wollongong, Campbelltown
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin
Canberra, Gold Coast, Sunshine Coast

Title **Generalised Soil and Rock Pressure Design Diagram Anchored or Propped Retaining Walls**

Office: Sydney	Scale: NTS	Date: 13 January 2009	Drawing No.5



Suggested Design Pressure Distribution

Cantilevered Retaining Wall

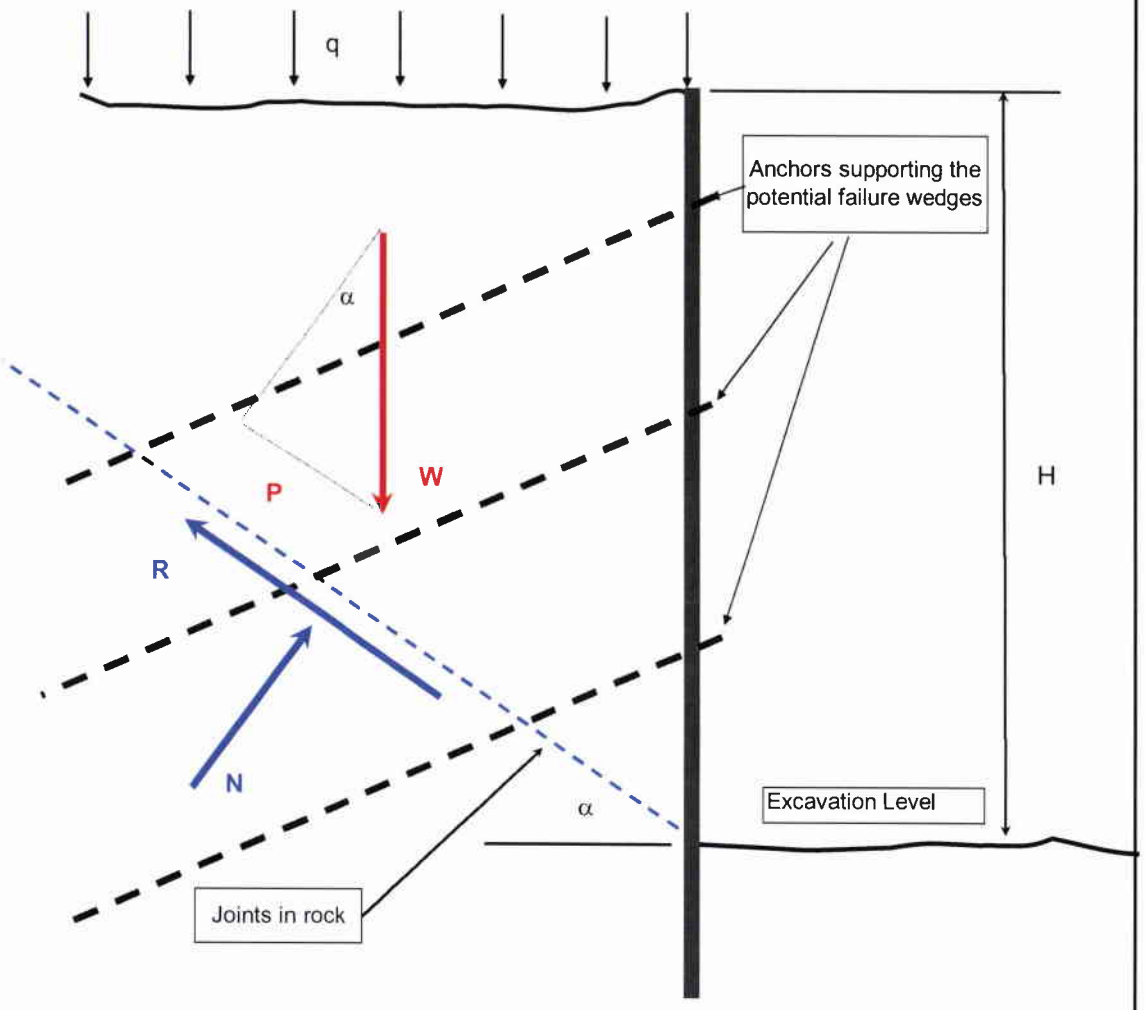
Notes

The possibility of 45° joints from the base of the excavation must be considered in the design.

P= soil pressure in kPa
H= height of wall above the level of Class III Rock
γ= soil/ rock unit weight (kN/m^3)

Douglas Partners Geotechnics · Environment · Groundwater	*Sydney, Newcastle, Brisbane, Wollongong, Campbelltown* *Melbourne, Perth, Wyong, Townsville, Cairns, Darwin* *Canberra, Gold Coast, Sunshine Coast*
Title	**Generalised Soil and Rock Pressure Design Diagram Cantilevered Retaining Walls**

Office: Sydney	**Scale: NTS**	**Date: 13 January 2009**	**Drawing No. 6**



Definitions

W is the weight of the sliding wedge (= $^{1}/_{2}\gamma H^{2}\cot\alpha$)

Q is the surcharge force on the surface of the wedge (=q H cot α)

N is the normal force on the sliding wedge [= (W+Q) cos α]

R is the resisting force along the wedge (= N tan ϕ)

P is the driving force along the sliding plane [= (W+Q) sin α]

Factor of Safety = R/P

$$= \frac{(W+Q)\cos\alpha \tan\phi}{(W+Q)\sin\alpha}$$

where ϕ= 15-25° for smooth planar continuous rock joints

and γ is the unit weight of the rock

Calculate additional resisting force imparted by anchors to achieve a satisfactory factor of safety

Douglas Partners
Geotechnics · Environment · Groundwater

Sydney, Newcastle, Brisbane, Wollongong, Campbelltown
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin
Canberra, Gold Coast, Sunshine Coast

Title **Generalised Wedge Analysis**
Anchored Retaining Walls in Jointed Rock

Office: Sydney	Scale: NTS	Date: 13 January 2009	Drawing No. 7

APPENDIX B
Notes Relating to this Report
Field Work Results

Douglas Partners
Geotechnics · Environment · Groundwater

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Douglas Partners
Geotechnics • Environment • Groundwater

DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

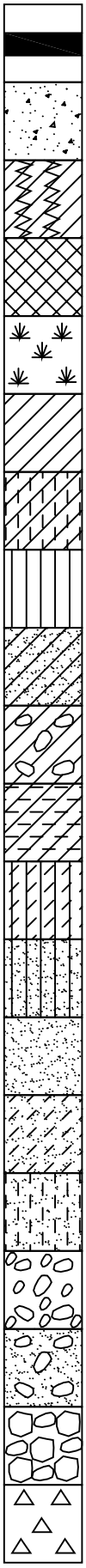
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SILT

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

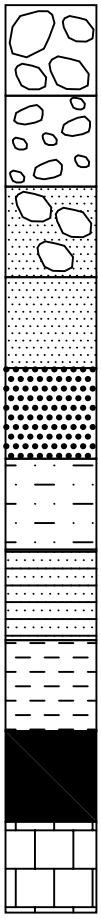
GRAVEL

SANDY GRAVEL

COBBLES/BOULDER

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

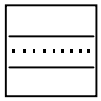
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

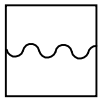
COAL

LIMESTONE

SEAMS

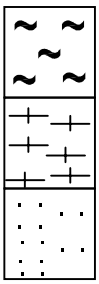


SEAM >10mm



SEAM <10mm

METAMORPHIC ROCK

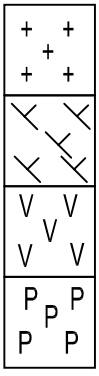


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

Douglas Partners

Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 93.2 AHD
EASTING: 321026
NORTHING: 6260287
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 45925
DATE: 15 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
93	0.4	FILLING - red and brown clay filling, with some rootlets and gravel. Damp							A			
	0.6	SILTY CLAY - dark brown, silty clay with some rootlets and ironstone gravel. Damp							A			
92	1.2	CLAY - very stiff, red brown clay. Damp							A			
		CLAY - very stiff to hard, light grey and red brown clay. Humid							S			4,6,8 N = 14
91	2.2	CLAY - very stiff to hard, light grey, red and orange clay with some ironstone bands										
90									S			6,14,16 N = 30
								Note: Unless otherwise stated, rock is fractured along rough, ironstained, planar bedding planes or joints dipping 0°- 10°				
89	4.45	LAMINITE/SILTSTONE - extremely low strength, extremely and highly weathered, light grey and brown laminite/siltstone 4.57-4.75m: medium strength band										
88	5.45	LAMINITE/SILTSTONE - low then medium strength, moderately weathered, fractured to slightly fractured, grey brown laminite with some extremely low strength bands						5.31-5.39m: J60°, ironstained (x3) 5.45m: J60°, clayey 5.65m: J40°, 10mm clay 5.75m: J30° 5.81m: J60°, smooth & clayey 5.85m: J70°, ironstained, clayey 6.08m: J35°, ironstained & clay 6.09m: J60°, ironstained & clay	C	100	21	PL(A) = 0.4MPa
86	7.1	LAMINITE - medium to high then high strength, moderately weathered then fresh, slightly fractured, grey brown then grey laminite (approximately 20% fine grained sandstone laminations)						6.17m: J20°, clayey 6.32m: J35°, smooth 6.38m: J85°, fractured 6.41m: J40°, ironstained 6.41-6.48m: clay 6.52m: J75° 6.54-6.60m J50°- 65°, ironstained (x7) 6.68m: J65°, smooth 6.7-6.75m: J60° (x3) 6.78-6.83m: J70°, ironstained (x3) 7.05-7.15m: J70° (x3) 7.15m: J85° 7.27m: J70°, ironstained 7.89m: J80°, ironstained	C	100	85	PL(A) = 1MPa PL(A) = 2.1MPa
84	9.0	Bore discontinued at 9.0m										

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 4.45m

TYPE OF BORING: Solid flight auger to 2.8m; Rotary to 4.5m; NMLC-Coring to 9.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed at completion of drilling

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED
Initials: AW
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 95.0 AHD
EASTING: 321058
NORTHING: 6260244
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 45925
DATE: 09 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
95	0.1	TOPSOIL - dark brown, sandy silty clay topsoil. Damp							A			
		CLAY - firm to stiff, red brown, light grey clay. Damp							A			
	0.8	SHALY CLAY - very stiff to hard, orange brown, light grey, shaly clay with some ironstone bands. Humid						Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°	A			
94	1								S			25/120mm refusal
	1.65	LAMINITE - very low to low strength, highly weathered, highly fractured to fractured, light grey and brown laminite						2.07m: J35° 2.08m: J80°, ironstained 2.09m: J70°, ironstained 2.1m: J30°, ironstained 2.12m: J25°, ironstained 2.21m: J80° 2.28m: J50° 2.5m: J70° 2.76m: J20°, ironstained 3.27m: J30°, ironstained	C	100	27	PL(A) = 0.2MPa
93	2							3.48m: J45°, ironstained 3.54m: J45°, ironstained				PL(A) = 0.8MPa
92	3											
	3.64	LAMINITE - medium strength, highly then moderately weathered, highly fractured to slightly fractured, grey and brown laminite						3.88m: J80°, ironstained 3.89m: J30°, ironstained 3.95m: J70°, ironstained 4m: J80°, ironstained 4.13m: J70°, clay 4.34m: J35°, ironstained 4.48m: J60°, ironstained				PL(A) = 0.8MPa
91	4											
								5.02m: J30°, ironstained				PL(A) = 0.6MPa
90	5							5.28m: J70°, ironstained 5.45m: J60°, ironstained 5.5m: J75°, ironstained 5.65m: J40°, ironstained 5.67m: J15°, ironstained 5.72m: J45°, ironstained	C	100	45	
89	6											PL(A) = 0.3MPa
	6.8	LAMINITE - medium strength, slightly weathered, fractured, grey laminite (approximately 20% fine grained sandstone laminations)						6.24m: J35° 6.39m: J60°, ironstained 6.52-6.58m: J30°- 50°, ironstained (x4) 6.69m: J35°				
88	7											
								7.08m: J20° 7.14-7.24m: J45°, ironstained (x4) 7.27-7.4m: J45°, ironstained (x6) 7.41m: J15°, ironstained 7.54m: J30°, ironstained 7.7m: J60°, smooth 7.85-7.93m: J30°- 50° (x4) 7.94m: J70° 7.95m: J30°, ironstained 8.03m: J80°, ironstained 8.21m: J70° 8.27m: J55°, ironstained 8.29m: J70°, ironstained 8.31m: J35° 8.46m: J60°, smooth 8.71m: J30° 8.73m: J40°	C	100	30	PL(A) = 0.6MPa
87	8											PL(A) = 0.4MPa
86	9											
	9.0	Bore discontinued at 9.0m										

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 1.65m

TYPE OF BORING: Solid flight auger to 1.42m; Rotary to 1.65m; NMLC-Coring to 9.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED
Initials: RLO
Date: 4.3.09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 94.7 AHD
EASTING: 321104
NORTHING: 6260218
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 45925
DATE: 09 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
94	0.2	TOPSOIL - dark brown, silty clay topsoil with rootlets							A			
		CLAY - stiff, red brown clay with a trace of ironstone gravel. Damp							A			
1	0.9	CLAY - very stiff to hard, red, grey clay with some ironstone bands. Humid							A			
	1.3	SHALY CLAY - hard, grey shaly clay with some ironstone bands. Humid						Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°	S			14,25/110mm refusal
93	2.1	LAMINITE - extremely low and very low to low strength, highly weathered, fragmented to fractured, light grey and red brown laminite with some medium strength bands						2.21m: J45°, clayey 2.31m: J60°, clayey 2.36m: J80°, clayey				PL(A) = 0.9MPa
2								2.67m: J40° 2.68m: J75° 2.71m: J45° 2.81m: J80°, ironstained	C	100	5	PL(A) = 0.6MPa
92								3.44m: J75°, ironstained 3.56m: J60°, ironstained 3.63m: J80°, ironstained				
3								3.96m: J45°, clayey				
91								4.29m: J75°, ironstained 4.36m: J50°, ironstained 4.37m: J30°, ironstained 4.56m: J70°, ironstained 4.69m: J85° 4.75m: J60°, ironstained 4.96m: J60°, ironstained 5.06m: J40°, ironstained 5.13m: J60°, ironstained	C	100	25	PL(A) = 0.6MPa PL(A) = 0.7MPa
4	4.57	LAMINITE - medium strength, moderately weathered, fractured to slightly fractured, brown and dark grey laminite (approximately 20% fine grained sandstone laminations)										
90								5.72m: J45°, ironstained 5.84m: J70°, ironstained 5.91m: J30°, ironstained 6.05m: J40°, ironstained 6.12m: J50°, ironstained				PL(A) = 0.8MPa
5	6.28	Bore discontinued at 6.28m										
89												
6												
88												
7												
87												
8												
86												
9												
85												

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 1.7m

TYPE OF BORING: Solid flight auger to 1.6m; Rotary to 2.1m; NMLC-Coring to 6.28m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLO
Date: 4.3.09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 96.1 AHD
EASTING: 321160
NORTHING: 6260225
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 45925
DATE: 10 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
96	0	FILLING - dark brown, black and orange-brown, gravelly clay filling with some sand. Damp							A			
									A			
95	1								A			
94	2											
	2.0	FILLING - blue-grey, black and brown, clay filling with a trace of rootlets. Moist							S			1,1,2 N = 3
93	3					▼						
	3.2	FILLING - dark grey clay with some gravel. Wet										
92	4								A			
	4.3	CLAY - dark brown and light brown clay with some ironstone							S			2,3,5 N = 8
91	5							Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°				
90	6											
	6.7	LAMINITE - low strength, moderately weathered, fragmented to fractured, brown laminite						6.7m: CORE LOSS: 140mm 7.01m: J50°, ironstained 7.03m: J80°, ironstained 7.08m: J40°, ironstained 7.13m: J65°, ironstained 7.28m: J85°, ironstained 7.39m: J40°, ironstained 7.43m: J85°, ironstained 7.56m: J55°, clayey 7.58m: J30°, ironstained 7.61m: J75°, ironstained 7.66m: J80°, ironstained 7.78m: J70°, ironstained	C	95	28	PL(A) = 1.5MPa PL(A) = 0.9MPa
89	7											
	7.73	LAMINITE - medium to high strength, slightly weathered, fractured to slightly fractured, grey laminite (approximately 20% fine grained sandstone laminations)										
88	8											
	8.65	Bore discontinued at 8.65m						8.06m: J30°, ironstained 8.38m: J65°, ironstained 8.57m: J50°, ironstained 8.65m: J50°				
87	9											

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 3.0m

TYPE OF BORING: Solid flight auger to 3.0m; Rotary to 6.7m; NMLC-Coring to 8.65m

WATER OBSERVATIONS: Groundwater observed at 3.0m during augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RWD
Date: 4.3.09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 100.5 AHD **BORE No:** 5
EASTING: 321228 **PROJECT No:** 45925
NORTHING: 6260253 **DATE:** 16 Dec 08
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
100	0.03	ASPHALT							A			
	0.1	FILLING - gravelly clay filling. Humid										
		FILLING - well compacted, orange, grey and red brown, clay filling with some gravel. Humid							A			
	0.8											
1		CLAY - very stiff to hard, light brown and grey clay with some ironstone bands. Humid							A			
	1.2											
99		SHALY CLAY - hard, light brown and grey, shaly clay with some ironstone bands. Humid							S			10/10mm refusal
2												
98								Note: Unless otherwise stated, rock is fractured along rough, ironstained, planar bedding planes or joints dipping at 0°- 10°				
3												
	3.2	LAMINITE/SILTSTONE - extremely low and extremely to very low strength, extremely to highly weathered, light grey brown laminite/siltstone with ironstone bands										
97												
4												
	4.26	LAMINITE/SILTSTONE - low to medium then very low strength, highly weathered, highly fractured to fractured, brown laminite/siltstone							C	100	35	
96								4.63m: J60°, ironstained 4.69m: J60°, ironstained				
	5.0	LAMINITE - medium strength, slightly weathered, fractured, grey brown laminite (approximately 20% fine grained sandstone laminations)						5.26m: J90°, ironstained 5.32m: J60° 5.4m: J60°, ironstained (x2) 5.47-5.57m: fractured zone				PL(A) = 0.4MPa
5												
95									C	100	73	
6	6.12	Bore discontinued at 6.12m						5.52m: J45°, clayey 5.9m: J80°, clayey				
94												
7												
93												
8												
92												
9												
91												

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 3.2m

TYPE OF BORING: Solid flight auger to 1.8m; Rotary to 3.2m; NMLC-Coring to 6.12m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed at completion of drilling

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLO
Date: 4 3 09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 101.8 AHD **BORE No:** 6
EASTING: 321085 **PROJECT No:** 45925
NORTHING: 6260342 **DATE:** 10 Dec 08
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
101	0	FILLING - dark brown, gravelly silty clay filling with some sand. Humid							A			
	1								A			
									A			
	1.6	CLAY - dark brown clay with some ironstone bands. Damp							S			2,3,5 N = 8
100	2							Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°				
	2.0	CLAY - orange-brown and grey clay with some ironstone bands. Humid										
99	2.8	LAMINITE - extremely low strength, extremely weathered, light grey and red laminite with some high strength ironstone bands						2.8m: CORE LOSS: 650mm	C	75	5	
	3											
98	4											
97	4.87	LAMINITE - very low strength, highly weathered, highly fractured to fractured, red brown and light grey laminite						4.92m: J20°, ironstained				
	5											
	5.4	LAMINITE - low strength, moderately weathered, highly fractured to fractured, brown and dark grey laminite						5.58m: J85°, ironstained 5.66m: J60°, ironstained 5.73m: J70°, ironstained 5.74m: J45°, ironstained 5.77m: J45°, ironstained 5.82m: J55°, ironstained 5.83m: J55°, ironstained 5.91m: J70°				PL(A) = 0.2MPa
96	6											
	6.0							6m: CORE LOSS: 50mm				PL(A) = 0.2MPa
95	6.9	LAMINITE - medium strength, moderately then slightly weathered, fractured to slightly fractured, brown and grey laminite (approximately 20% fine grained sandstone laminations)						6.08m: J70°, ironstained 6.33m: J85°, ironstained & clayey 6.45m: J75°, ironstained 6.55m: J80°, ironstained 6.74m: J70°, ironstained 6.91m: J75°, ironstained 7.05m: J45°, clayey & ironstained 7.18m: J80°, ironstained 7.25m: J85°, smooth 7.3m: J60°, ironstained	C	98	29	PL(A) = 0.5MPa
94	7											
	8											PL(A) = 0.7MPa
93	8.55	Bore discontinued at 8.55m						7.55m: J60°, ironstained 7.77m: J50°, ironstained 7.91m: J85°, ironstained 7.96m: J55°, ironstained 8.32m: J45°, ironstained 8.4m: J45°, ironstained 8.46m: J45°, ironstained				
	9											
92												

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 2.8m

TYPE OF BORING: Solid flight auger to 2.2m; Rotary to 2.8m; NMLC-Coring to 8.55m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RW
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 101.2 AHD **BORE No:** 7
EASTING: 321123 **PROJECT No:** 45925
NORTHING: 6260273 **DATE:** 10 Dec 08
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
101	0.05	ASPHALT							A			
	0.1	FILLING - grey sandy gravel filling										
		FILLING - red, dark brown and grey, clay filling with some gravel. Damp							A			
100	1								A			
	1.5	CLAY - light grey and red clay, with some ironstone bands. Damp							S			5,6,8 N = 14
99	2											
	2.0	SHALY CLAY - hard, light grey and orange, shaly clay. Humid						Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°				
98	3											
	3.55	LAMINITE/SILTSTONE - extremely low to very low strength, extremely to highly weathered, highly fractured, grey and orange laminite with some medium strength ironstone bands							C	94	0	PL(A) = 0.3MPa
97	4											
	4.71							4.71m: CORE LOSS: 100mm				
96	5											
	5.2	LAMINITE - medium strength, moderately weathered, highly fractured to fractured, grey and brown laminite with some extremely low and very low strength bands						5.25m: J80°, ironstained 5.27m: J60°, ironstained 5.34m: J60°, ironstained 5.38m: J45°, ironstained 5.52m: J55°, ironstained 5.7m: J85°, ironstained 5.89m: J45°, clayey 5.93m: J60°, ironstained 6.05m: J80°, ironstained 6.15m: CORE LOSS: 200mm 6.47m: J60°, ironstained 6.73m: J80°, ironstained 6.78m: J70°, ironstained 6.91m: J20°, ironstained 6.95m: J90°, ironstained 7m: J85°, ironstained 7.16m: J85°, ironstained 7.48m: J75°	C	93	45	PL(A) = 0.9MPa PL(A) = 0.6MPa PL(A) = 0.4MPa PL(A) = 1MPa
95	6											
	6.15											
94	7											
	7.0	LAMINITE - medium and high strength, fresh, slightly fractured to unbroken, grey laminite (approximately 20% fine grained sandstone laminations)										
93	8								C	100	100	PL(A) = 1.3MPa
	9											
92	9.04	Bore discontinued at 9.04m										

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 3.5m
TYPE OF BORING: Solid flight auger to 2.1m; Rotary to 8.55m; NMLC-Coring to 9.05m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials: RW
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 99.4 AHD
EASTING: 321188
NORTHING: 6260263
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 45925
DATE: 16 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
99	0.1	BITUMINOUS CONCRETE & ROADBASE							A			
		FILLING - orange brown and light grey, clay filling with some sand and gravel. Damp							A			
	1								A			
98									A			2,2,2 N = 4
	2											
97												
	3								S			2,3,5 N = 8
96												
	4											
95	4.6	CLAY - stiff to very stiff, light grey and red-brown clay, with some ironstone bands. Humid							S			2,4,6 N = 10
	5											
94								Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°				
	6	6.0 SHALY CLAY - hard, light grey shaly clay with some ironstone bands. Humid										
93		6.55 LAMINITE/SILTSTONE - extremely low to very low strength, extremely to highly and highly to moderately weathered, highly fractured to fractured, grey brown laminite/siltstone with some medium and low to medium strength bands						6.55m: CORE LOSS: 150mm 6.78-6.85m: fractured zone, clayey 6.85m: CORE LOSS: 50mm 7.29-7.36m: fractured zone 7.57-7.76m: fractured zone	C	90	20	
	7	6.85										
92												
	8							8.29m: J70°, clayey				
91		8.18 LAMINITE - medium then high strength, moderately weathered then fresh, fractured to slightly fractured, grey brown then grey laminite (approximately 20% fine grained sandstone laminations)							C	100	72	PL(A) = 0.7MPa PL(A) = 1.1MPa
	9											
90	9.45	Bore discontinued at 9.45m										

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 5.4m

TYPE OF BORING: Solid flight auger to 4.8m; Rotary to 6.55m; NMLC-Coring to 9.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLD
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 102.0 AHD **BORE No:** 9
EASTING: 321234 **PROJECT No:** 45925
NORTHING: 6260283 **DATE:** 17 Dec 08
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
102	0.1	PAVEMENT										
	0.4	CLAY - very stiff, light brown, shaly clay. Humid										
		SHALY CLAY - hard, light brown, shaly clay with some ironstone bands. Humid						Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°				
101	1											
100	2											
	2.0	LAMINITE/SILTSTONE - extremely low to very low and low strength, extremely to highly weathered, highly fractured to fractured, grey brown laminite with medium and medium to high strength ironstone bands							C	100	43	PL(A) = 1.4MPa
	2.64							2.52-2.65m: clay 2.64m: CORE LOSS: 140mm				
99	3							2.79-2.91m: fractured zone 2.97-3.07m: fractured zone 3.08m: J80°, smooth 3.13m: J85°, ironstained 3.19m: J60°, ironstained 3.24m: J75°, ironstained 3.34m: J85°, smooth 3.71m: J80°, clayey 3.73m: J60°, clayey 3.82-4.12m: J60°- 70°, clayey (x5) 4.27m: J75°, ironstained 4.37m: J80°, ironstained 4.42m: J60°, ironstained 4.51m: J85°, ironstained 4.72m: J78°, ironstained 4.92m: J80°, ironstained 5.0-5.10m: fractured zone 5.21m: J85°, ironstained 5.3m: J60°, ironstained 5.37m: J75°, ironstained 5.42m: J80°, ironstained 5.54m: J80°, ironstained 5.81m: J85°, ironstained 5.91m: J75°, ironstained 6m: J80°, ironstained 6.12m: J70°, ironstained 6.31m: J80°, clayey 6.4m: J65°, ironstained & clayey 6.41m: J65°, ironstained 6.53m: J85°, ironstained 6.58m: J60°, ironstained 6.59m: J65°, ironstained 7m: J80°, ironstained 7.14m: J60°, ironstained 7.38m: J80°, ironstained 7.4m: J65°, ironstained 7.52m: CORE LOSS: 150mm 7.77m: J65°, ironstained 7.83m: CORE LOSS: 150mm				
	3.7	LAMINITE - low then low to medium strength, moderately weathered, highly fractured to slightly fractured, grey brown laminite							C	94	13	PL(A) = 0.2MPa PL(A) = 0.3MPa
98	4											
97	5											
96	6								C	100	23	PL(A) = 0.4MPa
	6.78	LAMINITE - medium strength, slightly weathered, fractured to slightly fractured, grey brown laminite										PL(A) = 0.9MPa
95	7											
	7.52											PL(A) = 0.8MPa
	7.83								C	85	50	
94	8											
	7.98	LAMINITE - high strength, fresh, slightly fractured, grey laminite (approximately 20% fine grained sandstone laminations)										PL(A) = 1.6MPa
	8.85	Bore discontinued at 8.85m										
93	9											

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 2.0m

TYPE OF BORING: Solid flight auger to 1.1m; Rotary to 2.0m; NMLC-Coring to 8.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AUO
Date: 4-3-09

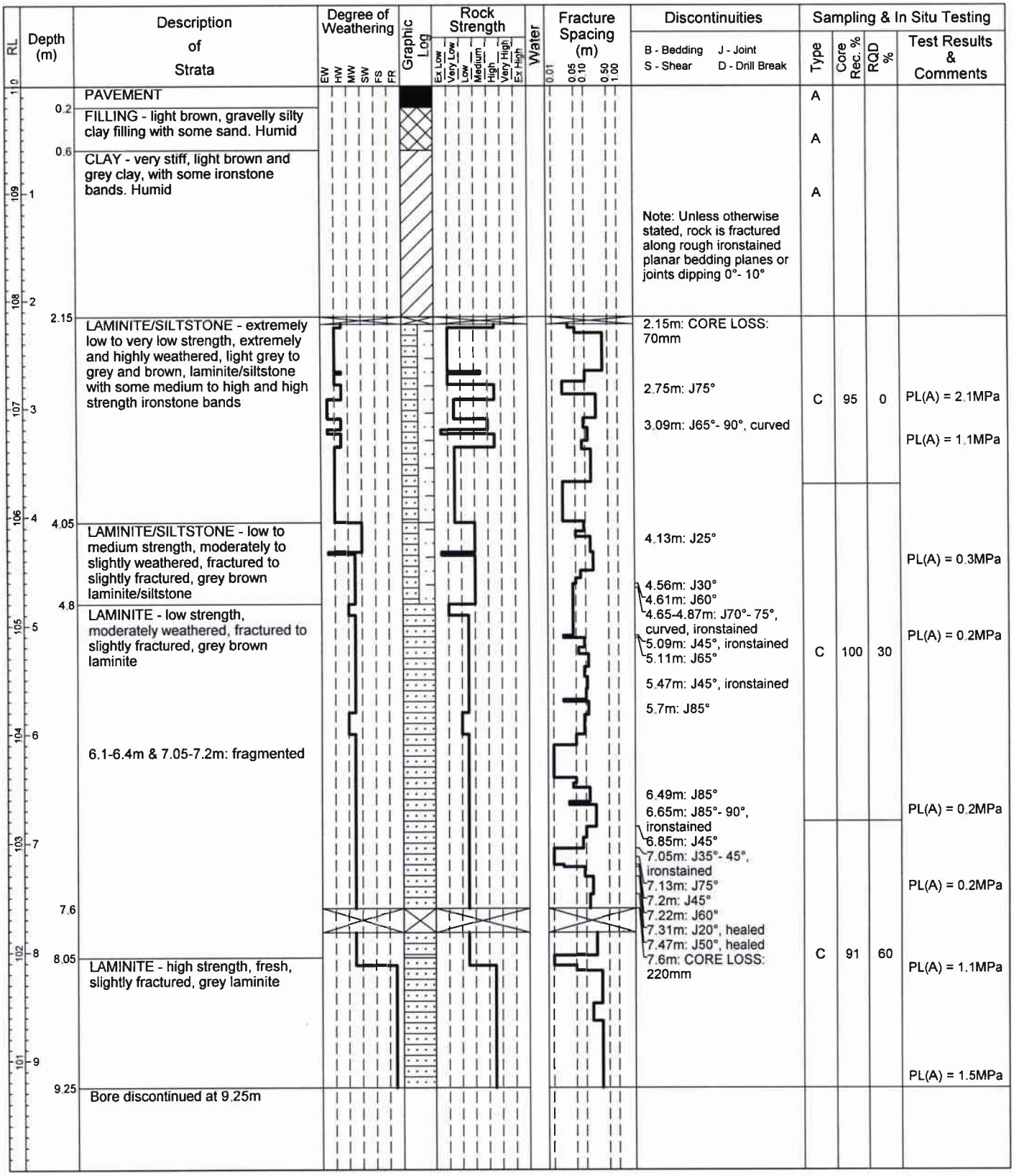
Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 110.0 AHD
EASTING: 321200
NORTHING: 6260362
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 45925
DATE: 19 Dec 09
SHEET 1 OF 1



RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 2.15m

TYPE OF BORING: Solid flight auger auger to 1.65m; Rotary to 2.15m; NMLC-Coring to 9.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AW
Date: 4.3.09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 111.6 AHD
EASTING: 321243
NORTHING: 6260387
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 45925
DATE: 19 Dec 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
111	0.2	PAVEMENT							A			
		FILLING - dark grey, orange and brown, clay filling with some sand and gravel. Moist							A			
110	1								A			
	1.9	CLAY - very stiff, light grey clay. Damp							S			1,1,2 N = 3
109	2.3	SHALY CLAY - very stiff to hard, light grey red brown, shaly clay with ironstone bands. Humid						Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°				
	3											
108	3.15	LAMINITE - low then extremely low to very low strength, extremely to highly weathered, fractured to slightly fractured, grey and red brown laminite with medium strength ironstone bands										PL(A) = 0.2MPa
	4							3.93m: J85°, partially healed 4m: J30°, clayey 4.22m: J75°				
107	4.42	LAMINITE - low to medium strength, moderately to slightly weathered, fractured to slightly fractured, grey brown laminite with medium strength bands						4.51m: J85° 4.59m: J45°	C	100	65	PL(A) = 0.3MPa
	5							5.12m: J85°				PL(A) = 0.3MPa
106	6											PL(A) = 0.5MPa
105	7							6.8m: J85°, ironstained				PL(A) = 0.4MPa
	7.0	LAMINITE - medium and high strength, slightly weathered then fresh, slightly fractured, grey laminite							C	100	93	
104	8							7.5m: J45°, rough				PL(A) = 1.3MPa
103	8.8	Bore discontinued at 8.8m										PL(A) = 0.8MPa
102	9											

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 3.15m

TYPE OF BORING: Solid flight auger to 2.8m; Rotary to 3.15m; NMLC-Coring to 8.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⫧	Water level

CHECKED
Initials: RLD
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 115.0 AHD **BORE No:** 13
EASTING: 321330 **PROJECT No:** 45925
NORTHING: 6260437 **DATE:** 21 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
115	0.2	PAVEMENT										
		CLAY - very stiff, red and grey clay, with some ironstone gravel. Humid						Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°	A			
114	1								A			
	1.25	SHALE/SILTSTONE - extremely low then extremely low to very low strength, extremely to highly weathered, light grey and red brown shale/siltstone, with some medium strength ironstone bands						1.25m: CORE LOSS: 50mm				
113	2								C	98	0	pp = 400kPa
112	3											pp = 250kPa
	3.85							3.85m: CORE LOSS: 60mm				
111	4											PL(A) = 1.1MPa
110	5								C	98	0	
	5.0	SHALE/SILTSTONE - low to medium strength, extremely to highly weathered, slightly fractured, light grey and orange brown shale/siltstone										PL(A) = 0.3MPa
	5.6	LAMINITE/SILTSTONE - very low strength, extremely to highly weathered, light grey brown, laminite/siltstone with extremely low strength bands										
109	6											
108	7							7.05m: J60°, healed 7.16m: J30°, healed 7.25m: 2 x J30°, 85°, steeped 7.45m: J45°, ironstained	C	100	10	
	7.6	LAMINITE/SILTSTONE - low to medium then very low strength, slightly then highly to moderately weathered, fractured to slightly fractured, grey brown laminite/siltstone										PL(A) = 0.3MPa
107	8							8.2m: J35°				
								8.6m: J85°, ironstained				PL(A) = 0.1MPa
	8.85	Bore discontinued at 8.85m										
106	9											

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 1.25m

TYPE OF BORING: Solid flight auger to 0.8m; Rotary to 1.25m; NMLC-Coring to 8.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed at completion of drilling

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLD
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 110.7 AHD
EASTING: 321272
NORTHING: 6260339
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 45925
DATE: 23 Dec 09
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
110	0	PAVEMENT							A			
	0.3	FILLING - poorly compacted, orange brown, clay filling with some ironstone gravel, damp							A			
109	1								A			
									A			
									S			2,2,2 N = 4
108	2											
									S			3,3,3 N = 6
107	3											
	4.0	CLAY - very stiff to hard, orange and grey clay with ironstone bands, moist							S			6,10,15 N = 25
106	4											
105	5											
104	6							Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°				
	7											
103	7.2	LAMINITE - low and low to medium strength, moderately to slightly weathered, fragmented to fractured, grey and brown laminite						7.35m: J45°				
	8.0	LAMINITE - very low to low strength, highly to moderately weathered, fractured to slightly fractured, grey brown laminite						7.8m: B0°, 2mm clay 7.92m: J60°, clayey 8.06m: 2 xJ65°, 70°, clayey	C	100	0	
102	8							8.54m: B20°, 10mm clay				
	9							8.85m: J45°, clayey 9.03m: J60°, ironstained				
101								9.42m: J45°, clayey 9.55m: J35°, 10mm clay	C	93	47	

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 5.0m

TYPE OF BORING: Solid flight auger to 5.0m; Rotary to 7.2m; NMLC-Coring to 11.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AW
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 110.7 AHD
EASTING: 321272
NORTHING: 6260339
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 45925
DATE: 23 Dec 09
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
100	10.0 10.17	LAMINITE - low then medium to high strength, slightly weathered then fresh, slightly fractured, grey laminite						9.89m: J75° 10m: CORE LOSS: 130mm 10.3m: 2 xJ85°, 75° 10.4m: J75°	C	93	47	PL(A) = 0.6MPa PL(A) = 1.1MPa
99	11.45	Bore discontinued at 11.45m										

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 5.0m

TYPE OF BORING: Solid flight auger to 5.0m; Rotary to 7.2m; NMLC-Coring to 11.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLD
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 114.0 AHD
EASTING: 321282
NORTHING: 6260414
DIP/AZIMUTH: 90°/--

BORE No: 16
PROJECT No: 45925
DATE: 18 Dec 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
114	0.05	ASPHALT							A			
	0.2	FILLING - clayey gravel filling										
		SANDY CLAY - very stiff, light brown, sandy clay, humid							A			
113	1 1.0	CLAY - dark red and light grey, clay with ironstone gravel						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	A			
	1.7	LAMINITE/SILTSTONE - extremely low to very low strength, extremely to highly weathered, fractured to slightly fractured, light grey and brown, laminite/siltstone with medium strength ironstone bands						1.7m: CORE LOSS: 180mm 2.21m: CORE LOSS: 140mm 2.59m: J50° 2.68m: J35° 3.07m: J35° 3.43m: J90°, ironstained 3.7m: B20°, 30mm clay band 3.78m: J30°	C	86	0	PL(A) = 0.8MPa
112	2											
	2.21											
111	3											
	4.05	LAMINITE/SILTSTONE - low strength, highly to moderately weathered, fractured to slightly fractured, grey brown laminite/siltstone						4.42m: J20°, healed, ironstained 4.72m: CORE LOSS: 130mm	C	87	41	PL(A) = 0.2MPa
110	4											
	4.72	LAMINITE/SILTSTONE - extremely low to very low strength, extremely to highly weathered, light grey laminite/siltstone, with medium strength ironstone bands						5.2m: B15°, ironstained 5.27m: J25°, ironstained 5.35m: J35°, smooth 5.48m: CORE LOSS: 140mm 5.65m: J60°, ironstained 6m: J70°				PL(A) = 0.2MPa
109	5											
	5.48											
	5.75	LAMINITE - low strength, slightly weathered, fractured to slightly fractured, grey laminite										PL(A) = 0.2MPa
108	6											
107	7								C	100	88	
	7.5	LAMINITE - low to medium then medium strength, fresh, slightly fractured, grey laminite (approximately 20% fine grained sandstone laminite)						7.45m: J70°, ironstained				PL(A) = 0.3MPa
106	8											
	8.55	Bore discontinued at 8.55m										PL(A) = 0.4MPa
105	9											

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH/SI **CASING:** NW to 1.7m

TYPE OF BORING: Solid flight auger to 1.2m; Rotary to 1.7m; NMLC-Coring to 8.55m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLD
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Broadcasting Property Pty Ltd
PROJECT: Epping Park
LOCATION: 61 Mobbs Lane, Epping

SURFACE LEVEL: 115.0 AHD **BORE No:** 18
EASTING: 321377 **PROJECT No:** 45925
NORTHING: 6260425 **DATE:** 18 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
115	0.2	PAVEMENT										
		FILLING - orange brown and dark red, clay filling with some gravel and sand. Humid						Note: Unless otherwise stated, rock is fractured along rough planar bedding plane or joints dipping 0°- 10°				
114	1											
	1.2	CLAY - very stiff, red and brown clay with some ironstone bands. Humid										
	1.75	LAMINITE - extremely low strength, extremely weathered, fractured, grey and red laminite with some ironstone gravel bands										pp>600kPa
113	2											
	2.3							2.3m: CORE LOSS: 350mm				pp=450kPa
112	2.9							2.9m: CORE LOSS: 250mm	C	66	64	
	3											
	3.3							3.3m: fragmented zone 3.3m: CORE LOSS: 250mm				pp=500kPa
111	4											
	4.25	LAMINITE - extremely low strength, highly weathered, highly fractured to fractured, light grey and orange laminite with some extremely weathered zones and some ironstone bands						4.36m: J50°, ironstained 4.67-4.81m: fragmented				pp>600kPa
110	5							4.88-4.89m: J60°, ironstained 4.92-5.0m: fragmented zone 5.06m: J55°, ironstained	C	100	75	pp>600kPa
	5.55							5.06-5.08m: fragmented zone 5.08m: J55°, ironstained 5.08-5.32m: J60°, ironstained (x3) 5.55m: CORE LOSS: 200mm	C	81	72	pp>600kPa
109	6											
	6.55							5.75-5.80m: fragmented 5.8m: J45°, ironstained 6.02m: J70°, clayey 6.21m: J45°, ironstained 6.23m: J20°, ironstained 6.24m: J70°, clayey 6.55m: CORE LOSS: 125mm	C	82	39	
108	6.95											
	7											
	7.59							6.82-6.96m: fragmented zone 6.86m: J55°, ironstained 6.9m: J45°, ironstained 6.95m: CORE LOSS: 50mm				pp>600kPa
107	8								C	87	47	
	8.1							7.22, 7.24, 7.25, 7.35, 7.37m: J55°, ironstained/ironstone 7.59m: CORE LOSS: 120mm				pp=550kPa
	8.34											pp=350kPa
106	9											
	9.15							7.72m: J50°, clayey 8.1m: CORE LOSS: 100mm				pp=350kPa
	9.4							8.23, 8.25m: J60°, ironstained 8.34m: CORE LOSS: 70mm	C	91	75	pp=350kPa

RIG: Edson 3000 **DRILLER:** John Simon **LOGGED:** PH **CASING:** NW to 1.75
TYPE OF BORING: Solid flight auger to 1.75m; NMLC-Coring to 13.27m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RLO
Date: 4-3-09

Douglas Partners
Geotechnics · Environment · Groundwater