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REPORT on GEOTECHNICAL INVESTIGATION

PROPOSED MEDICAL CENTRE 26 BIGGE STREET, LIVERPOOL

Prepared for KORDAN PTY LTD

Project 45575
May 2008

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REPORT ON GEOTECHNICAL INVESTIGATION
PROPOSED MEDICAL CENTRE
26 BIGGE STREET, LIVERPOOL

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out on the site of a proposed multi-storey medical centre to be constructed at 26 Bigge Street, Liverpool. The work was commissioned by Mr Henry Ah Cann of Brown Consulting (NSW) Pty Ltd on behalf of the property owners Kordan Pty Ltd.

The construction of an eight storey medical centre with two levels of basement car parking is proposed for a vacant site between an existing medical centre and a private hospital. Investigation was required to provide information on the subsurface conditions for the design of foundations, retaining structures and floor slabs and to assess excavation conditions on the site.

The investigation comprised five test bores followed by logging, core photography and engineering evaluation. Details are given in the report together with suggested design parameters and comments on design and construction practice.

The investigation was carried out in conjunction with sampling for a waste classification for excavated materials. The results of the waste classification investigation will be provided in a separate report.

2. SITE DESCRIPTION

The site is approximately rectangular in shape with a frontage of about 30 m on Bigge Street and a rear laneway and an overall depth of 48 m. The site slopes very gently towards the south. At the time of investigation the former structures on the site and most vegetation had been removed.

The site is located between two multi-storey developments which both have subsurface parking areas supported by blockwork walls along the boundaries with the subject site. The building to the north houses the South-Western Day Medical Centre whilst the building immediately to the south is the Sydney South-Western Private Hospital.

3. REGIONAL GEOLOGY

Reference to the 1:100 000 Series Geological Map for Penrith indicates that the site is probably underlain by Bringelly Shale of Triassic age. Bringelly Shale typically comprises siltstone, fine grained sandstone and laminites with some shale bands. The area, however, is shown on the map as being close to the boundary between the Bringelly Shale and more recent alluvium laid down in the floodplain of the nearby Georges River. There was therefore a possibility that alluvial soils could be encountered overlying the weathered residual soils and the bedrock. Detailed logging of the test bores indicates that the site is underlain by a shallow depth of filling and silty clay and then weathered siltstone to the full depth of testing. This sequence confirms that there are no extensive alluvial deposits on the site and that most of the material, other than the near surface filling, is derived from the Bringelly Shale.

4. SITE INVESTIGATION METHODS

The site investigation comprised five bores drilled to depths of 9.7 m below existing surface levels using a combination of spiral flight augers in the near surface soils and rotary core drilling in the bedrock. Standard penetration tests were conducted at regular depth intervals in the

soils down to bedrock level to provide information on the engineering properties of the strata. The Standard Penetration Test also recovers partially disturbed samples which can be utilised for engineering and contamination testing.

On reaching the level of the bedrock, rotary core drilling commenced using NMLC sized core barrels to obtain 50 mm diameter samples of the bedrock strata. The bores were continued to a depth of about 2 m below expected excavation level and were generally terminated in medium strength rock.

Upon completion of the investigation, three of the bores were backfilled with spoil material obtained from the bores whilst two bores (BH1 and BH5) were converted into standpipe piezometers to measure the long term groundwater levels. Slotted PVC tubing (50mm diameter) was inserted into the bore with the annulus between the bore wall, and the slotted casing filled with coarse sand and then capped to prevent inflow of surface water into the piezometer. The piezometers were finished with a gatic cover to minimize the risk of unauthorized usage.

The location of the bores is given on Drawing 1 in Appendix A. The surface levels at each bore location were determined by surveying relative to a benchmark on top of the kerb near the south-western corner of the block.

5. FIELD WORK RESULTS

The detailed bore logs and core photographs are provided in Appendix B which also contains notes defining the terms which are used to describe the strata and the rock strength classification.

The bores encountered relatively uniform conditions over the site with filling and very stiff or hard clay or shaly clay to depths of 1.8 to 3.0 m overlying extremely low strength siltstone. The extremely low strength rock generally continued to depths of about 3 – 4.5 m where variably weathered, fractured, low to medium strength rock with some extremely low strength bands was encountered. Fresh to slightly weathered, medium strength rock was intersected in most of the

bores below depths of 5 - 8 m. The depths varied across the site indicating that there is some considerable variation in the depth of weathering on the site.

Table 1 shows a summary of the levels at which each of the strata were encountered in the bores. These indicate some variation across the site which is typical for sites underlain by Bringelly Shale.

Table 1 – Summary of Strata

Strata Description	RL of Interface (m AHD)				
	BH1	BH2	BH3	BH4	BH5
SL	12.3	12.8	12.6	12.3	12.7
TOPSOIL/FILLING – clay and gravel filling with some concrete and brick fragments					
	11.6	12.6	12.4	11.6	12.5
CLAY/SILTY CLAY – generally very stiff with some shaly clay					
	10.5	10.7	9.6	10.3	12.0
SILTSTONE – extremely low to very low strength siltstone					
	9.3	9.8	9.5	7.6	9.6
SILTSTONE - low to medium strength, fractured siltstone with some extremely low strength bands					
	4.6	7.7	5.1	4.3	4.7
SILTSTONE – medium strength, slightly weathered to fresh, slightly fractured siltstone					L-M
	2.6	3.1	2.9	2.6	3.0
	BD	BD	BD	BD	BD

BD = Bore discontinued L-M = Low to Medium SL = Surface Level

No free groundwater was encountered whilst augering through the near surface soils and it was not possible to observe any permanent groundwater levels once rotary core drilling commenced because water is used as a flushing medium during the coring process. Two standpipe piezometers were installed immediately upon completion of the drilling and these were bailed dry on 8 May, 2008. Subsequently, the depth to groundwater was measured at each of these two locations on 21 May, 2008. The results show that the groundwater level is below the depth of 8.2 m in BH 1. BH 5 was dry to a depth of 8.5 m. It is possible that the water within BH 1 at the date of measurement is due to slight seepage along the clay / siltstone interface.

6. PROPOSED DEVELOPMENT

It is understood that the proposed development comprises an eight level medical centre with two levels of basement car parking. The drawings provided indicate that the excavation extends almost up to the common boundaries between the subject property and adjoining properties on the northern and southern side of the site. At this stage no information has been provided on the likely foundation loads but given the scope of the development it is likely that loads of the order of 5,000 to 7,000 kN would occur.

The bulk excavation level is understood to be RL 5.7 m with pad footings under the columns founded at about RL 5.3 m. This means that excavation depths of the order of 7 m will be required as part of the bulk excavation.

7. ENGINEERING EVALUATION

The proposed development comprises excavation to depths of about 7 m in close proximity to adjoining buildings which are known to have basements at about 1.5 to 2 m below existing natural surface level. The proposed excavation will therefore be about 5 m below the foundation levels of the adjoining structures. Assuming that these buildings are founded on shallow footings, the provision of adequate support for boundary foundations and for the floor slabs will be a critical issue for the current development. Other important geotechnical aspects of the development include:

- the excavatability of the soil;
- provision of excavation support and suitable batter slopes, if feasible;
- design of retaining walls;
- vibrations that will occur during excavation and its impact upon adjoining structures;
- foundation design for both pad footings and raft slabs;
- groundwater levels and probable seepage;
- soil aggressivity and its impact on buried concrete structures.

Comments on these aspects of the development are provided in the subsections below.

7.1 Site Conditions

The investigation indicates that the site is underlain by 2-3 metres of filling and silty clay overlying extremely low strength to very low strength siltstone which continued to depths of about 3 – 4.5 m below existing surface level. Below that depth the bores intersected low strength or low to medium strength fractured rock with some extremely low strength bands. Generally, at about RL 5 consistently medium strength slightly fractured siltstone was encountered and this continued to the termination of the bores at approximately 10 m below existing surface level.

The descriptions given above are simplified and the conditions on the site vary with the depth of weathering and the degree of fracturing being somewhat different between the bores.

7.2 Excavation

The results of the investigation indicate that the bulk excavation will be through filling and clay and then weathered rock which varies in strength from extremely low strength to medium strength. It is anticipated that bulk excavation of the clays could be readily achieved using conventional earthmoving equipment but moderately hard ripping is expected within the low and medium strength rock units.

The degree of difficulty in any excavation is a function of rock strength and fracturing and also the type of equipment used and the skill of the machine operator. It is therefore suggested that the tenderers be required to inspect the core and the core photographs and make their own judgment on the equipment required to carry out the work and the rate at which excavation can be performed. In this way, the contractors should be able to provide a single unit rate for excavation regardless of material encountered. Such a contract generally precludes any claims for extras on the basis of difficulties with excavation because it puts the onus squarely on the contractor to assess the site conditions and the equipment needed to achieve bulk excavation.

In carrying out the excavation some vibration can be anticipated. Further advice is provided on this aspect in Section 7.5.

Materials excavated from the site including the near surface filling and overburden soils are expected to be disposed off site and as such require classification in accordance with "Environmental Guidelines: Assessment Classification and Management of Non-Liquid Waste (NSW EPA 1997)" prior to disposal. A separate waste classification report is being prepared on this aspect of the work.

7.3 Excavation Support and Batter Slopes

In areas set back from the adjacent site or street frontages it may be possible to construct temporary batters while conventional retaining walls are erected. Recommended safe batter slopes in filling and the very stiff and hard clay are 1V:1H for temporary batter slopes up to 3 m high. Depending upon the conditions encountered during the excavation and the prevailing weather it may also be necessary to pin and shotcrete the temporary batters to prevent fretting and local slumping failures.

Where excavation takes place up to within 5 m of the common property boundaries some form of support will be needed, particularly as the excavation is expected to be about 5 m below the adjoining basement levels. For this reason it is recommended that a contiguous bored pile retaining wall be installed prior to excavation to provide support at these locations. The bored pile wall could be designed as a cantilevered structure and maybe utilised as part of the permanent basement retaining walls. The walls on all sides will need to be cantilevered as it is unlikely that anchors can be installed safely without compromising the performance of the foundations of the adjoining structures or utilities in the road way at the front and rear of the site. It is also unlikely that permission can be obtained to install temporary anchors given the sensitivity of the adjoining buildings to being disturbed by under-drilling or the possibility that anchors may have an adverse impact on utilities in Bigge Street or the rear lane way.

In the project brief it was suggested that support may be obtained by drilling soldier piles with infill shotcrete panels. This may be feasible on the front and rear boundary of the site provided shotcreting takes place for every 2 m lift of the excavation but it is not recommended along the sides of the property where excavation is within 5 m of the common boundaries. The possibility of undermining the footings or floor slabs of the adjoining structures and the perimeter retaining walls is considered too risky and therefore a contiguous pile wall is recommended.

7.4 Retaining Wall Design

In carrying out the design of permanent and temporary retaining walls it is considered that the design parameters provided in Table 2 could be adopted.

Table 2 – Retaining Wall Design Parameters

Soil Strata	Unit Weight (kN/m^3)	Active Earth Pressure Coefficients		Passive Earth Pressure Coefficient	
		Temporary	Permanent	Temporary	Permanent
Filling or Clay	20	0.25	0.35	4.0	3.0
Extremely low strength Siltstone	20	0.20	0.30	5.0	3.5
Low to medium strength Siltstone	21	0.1	0.1	1500 kPa	1000 kPa
Medium strength Siltstone	21	0.0	0.0	3000 kPa	1500 kPa

7.5 Vibration

7.5.1 General

Excavation to depths of about 7 m will encounter filling and clay and extremely low then low and medium strength siltstone. Excavation of the near surface materials and the extremely low strength siltstone should produce little vibration apart from that which normally occurs with machinery moving around a construction site. However, excavation within the low and medium strength rock may require the use of rock breaking equipment or heavy ripping using a dozer with a single tyne ripper. These sorts of equipment create vibrations which can be transmitted to the foundations of adjoining structures. As the adjoining buildings are multi-storey structures these vibrations can be amplified in the upper floors and therefore it will be necessary to use appropriate methods and equipment to keep ground vibrations at the adjacent buildings within acceptable limits.

7.5.2 Regulations

There are no current Australian Standards for vibrations generated by construction plant, but AS2187 (Explosives Code) recommends a maximum vector sum Peak Particle Velocities (PPV) of 10 mm/sec for houses and low rise residential buildings. However the explosive code notes that these values are not applicable to specialist structures such as dams, reservoirs, hospitals

or buildings housing scientific equipment which is sensitive to vibrations. Therefore there is no guidance as to the levels of vibration which would be acceptable for the adjoining private hospital or medical centre.

At this stage it is recommended that a peak particle velocity of 3 mm/sec be adopted but this needs to be confirmed on site and with adjoining owners to ensure that any equipment they use will not be damaged or the performance of the equipment compromised by excavation on this site. Any vibration level adopted should apply at the foundation levels of the adjacent structure.

The current Department of Environment and Climate Change (formerly the Environmental Protection Authority) guidelines on vibration indicate that PPV for critical working areas such as hospital operating theatres and scientific laboratories should not exceed 0.28 mm/sec. The transmission of vibration from the building foundations through the structure will depend upon the degree of damping that takes place and will also be a function of the frequency of the vibration. For this reason, it is considered essential that a vibration trial be conducted during the initial stages of construction. Ideally this would involve the use of equipment that is going to be used to carry out the excavation but it may be sufficient to create vibrations outside the existing hospital with a vibrating roller and measure the vibrations at foundation level and in any operating theatres. In this way, the degree of attenuation and damping caused by the building can be determined so that the required PPV at foundation level can be set.

7.5.3 Excavation Methodology

If hydraulic rock hammers are used in the excavation, there will be a need to develop procedures to minimise the effects of vibration. The appropriate work methods should allow for:

- Excavation of loose or rippable blocks by bucket prior to commencement of any rock hammering. Care should be taken to ensure that any loosened blocks do not extend beneath adjoining buildings.
- Progressive breakage of the rock from open excavated faces.
- Selective breaking along open joints where these are present.
- Movement of large blocks away from the sensitive structures prior to breaking up for transport from the site.

Even with these precautions there is a strong possibility that the use of hydraulic rock hammers may be severely restricted in time and spatially. To avoid any delays in commencing with the excavation, it is recommended that adjoining owners be consulted regarding their requirements with regards to vibration and noise.

As excavation takes place, it will be essential that vibration monitoring is undertaken to ensure that the predetermined vibration levels are not exceeded by the contractor.

7.5.4 Vibration Trial

On the assumption that the adjoining medical centre and private hospital have equipment which is sensitive to vibration and the possible distress which patients may feel if subjected to vibration, it is strongly recommended that a vibration trial be undertaken in the initial stage of the excavation to develop a site specific relationship between the PPV and the distance of various equipment from the boundaries. At the same time vibration monitoring should take place within the adjoining buildings at sensitive locations so that the extent of any attenuation within the structure can be determined. The contactor will then have specific targets and will be able to select the equipment appropriate to material being excavated. There is a strong possibility that the use of rock saws or milling heads may be necessary in order to limit vibrations to acceptable levels.

7.5.5 Dilapidation Survey

Excavation of low and medium strength rock will undoubtedly transmit some vibrations to adjacent structures if these are founded on the same materials. For this reason it is suggested that a dilapidation survey be carried out on all adjoining structures so that any pre-existing structural or cosmetic damage can be identified before work commences. A comparative survey can then take place at the completion of construction to determine whether work on site has led to any deterioration in the condition of the surrounding structures.

7.5.6 Monitoring

As the excavation will take place adjacent to structures which are probably highly sensitive to vibration, it is essential that vibration monitoring continues at all times while excavation takes place. The monitors should be fitted with alarms which are triggered at predetermined PPV

levels so that the contractor knows when his equipment or procedures are creating potential problems within the hospital or medical centre.

7.6 Foundations

Low to medium strength siltstone bedrock was encountered at the anticipated bulk excavation level. Pad footings founding in this low or medium strength siltstone may be proportioned on the basis of an ultimate bearing pressure of 10 MPa. In order to limit settlements to less than about 1% of the minimum footing dimension, it is suggested that an allowable bearing pressure of 2.5 MPa should be adopted for this material. All foundations should be inspected by an experienced geotechnical engineer to confirm that the material is uniformly low or medium strength siltstone suitable for the design bearing pressure before reinforcement cages are placed and concrete poured.

7.7 Floor Slabs on Ground

In the base of the excavation low or medium strength rock will be exposed. On this basis it is considered that a modulus of subgrade reaction of 100 kPa/mm could be used for the design of floor slabs subjected to loads restricted to an area of 1 m by 1 m.

7.8 Groundwater Levels and Seepage

Monitoring of the groundwater levels during construction and subsequently has indicated that the groundwater is at a depth of at least 8 m below existing surface levels. Consequently it is considered there is no special provision required for the design of floor slabs for uplift or for permanent hydraulic loads on retaining walls. There will, however, be some seepage along some bedding planes or highly fractured zones and it will therefore be necessary to make provision for pumping seepage water out of the excavation during construction.

7.9 Soil Aggressivity

The investigation encountered filling, clay and weathered Bringelly Shale which is known to have been deposited in a marine environment. Testing throughout the Sydney Basin has shown that much of the salt laid down with the sediments is still present within these bedrock units. Relatively high chloride and sulphate concentrations are regularly recorded within seepage water and groundwater extracted from the Bringelly and Ashfield Shales. It is therefore recommended that design of concrete structures be undertaken assuming a moderate aggressivity for the surrounding materials.

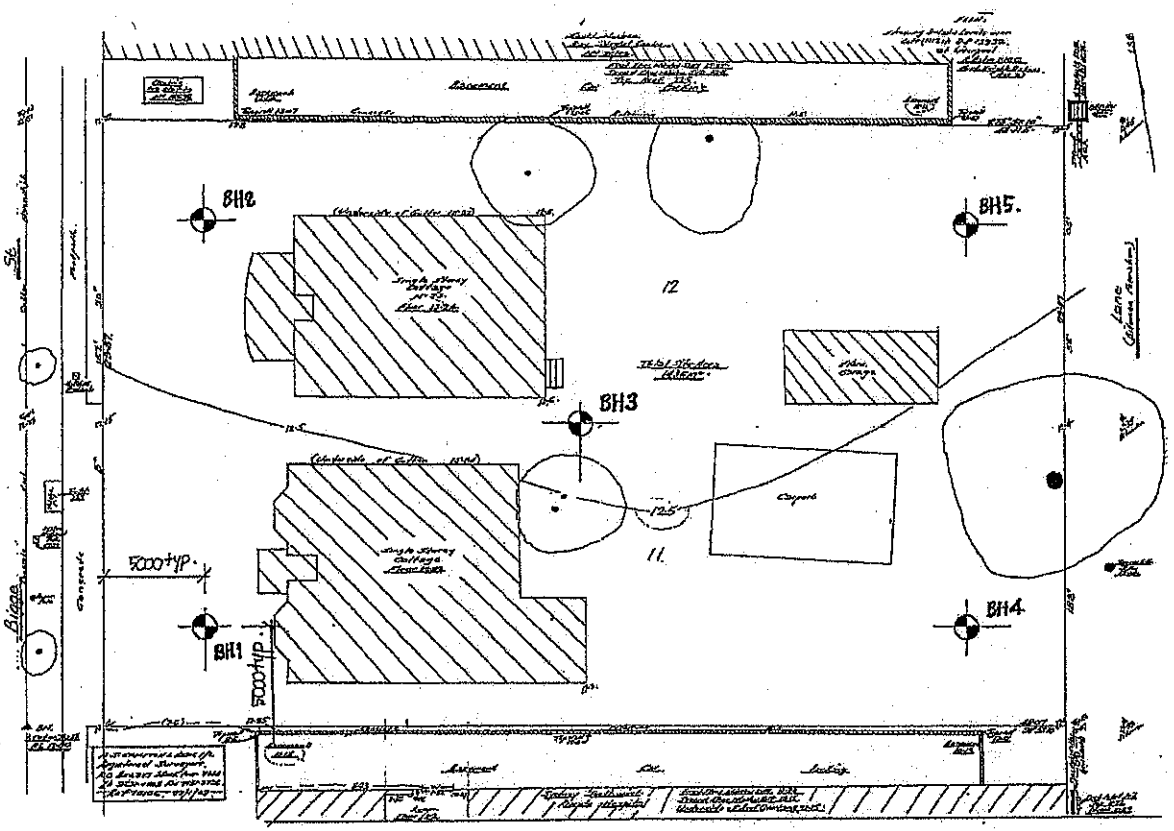
DOUGLAS PARTNERS PTY LTD

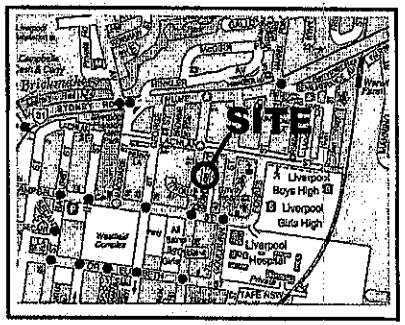
Reviewed by

Michael J Thom
Principal

Fiona MacGregor
Principal

APPENDIX A
Drawings





LOCALITY PLAN

LEGEND

⊕ TEST BORE LOCATION

SCALE 1:250

0 5 10 15m

Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Brown Consulting		OFFICE: SYDNEY	TITLE: **Location of Tests Proposed New Medical Centre 26 Bigge Street LIVERPOOL**	DRAWING No: 1
	PROJECT No: 45575		DRAWN BY: PSCH		
	DATE: 16.5.2008	SCALE: As shown	APPROVED BY:		

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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.

APPENDIX B
Bore Logs

BOREHOLE LOG

CLIENT: Brown Consulting (NSW) Pty Ltd
PROJECT: Proposed Medical Centre
LOCATION: 26 Bigge Street, Liverpool

SURFACE LEVEL: 12.3
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/–

BORE No: 1
PROJECT No: 45575
DATE: 13 May 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
12	0.2	FILLING - brown and orange brown, gravelly, fine to medium grained sand filling with concrete gravel, humid										
	0.5	FILLING - brown and orange brown silty clay filling, moist										
11	1	FILLING - dark brown silty clay filling, with some fine to medium gravel of sandstone, brick fragments, moist							S			10,15,21 N = 36
	1.8	SILTY CLAY - very stiff, red brown and grey silty clay										
10	2	SILTSTONE - extremely low to very low strength, extremely to highly weathered, grey and brown siltstone with medium strength ironstone bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	–			
									S			15,25/90mm refusal
9	3.0	SILTSTONE - low strength, highly weathered, slightly fractured, grey brown siltstone with some sandstone laminations						3.19-3.31m: J85°, irregular rough 3.31-3.74m: B5°, clay	C	86	0	
	3.74											
	3.95	SILTSTONE - extremely low strength, extremely weathered, dark grey siltstone						3.95m: CORE LOSS: 150mm				
8	4.1	SILTSTONE - medium strength, moderately to slightly weathered, fractured, grey brown siltstone with sandstone laminations and high strength ironstone bands						4.57-4.64m: J90°, irregular rough 4.69-4.75m: J70° planar smooth 4.81-4.88m: J90° irregular rough 5.4m: B0°- 5°, clay	C	86	14	PL(A) = 0.5MPa
	5											PL(A) = 0.6MPa
7	5.57							5.57m: CORE LOSS: 230mm				
	5.8	SILTSTONE - low to medium strength, slightly weathered then fresh, fractured, grey thinly laminated siltstone with medium strength ironstone bands							C	85	11	PL(A) = 0.3MPa
	7											
6	7.42							7.39-7.41m: J60° 7.42m: CORE LOSS: 280mm				
	7.7	SILTSTONE - medium strength, fresh, fractured, grey, thinly laminated siltstone						7.84-8.0m: J90°	C	100	17	PL(A) = 0.3MPa
	8							8.22-8.32m: B5°, clay				PL(A) = 0.9MPa
5	9								C	100	15	PL(A) = 0.7MPa
4	9.7	Bore discontinued at 9.7m - limit of investigation										

RIG: DT 100 DRILLER: L Cooper LOGGED: Beckett CASING: HQ to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.50m; Rotary to 3.0m; NMLC-Coring from 3.0m to 9.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 9.7m

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:
Date: 3/06

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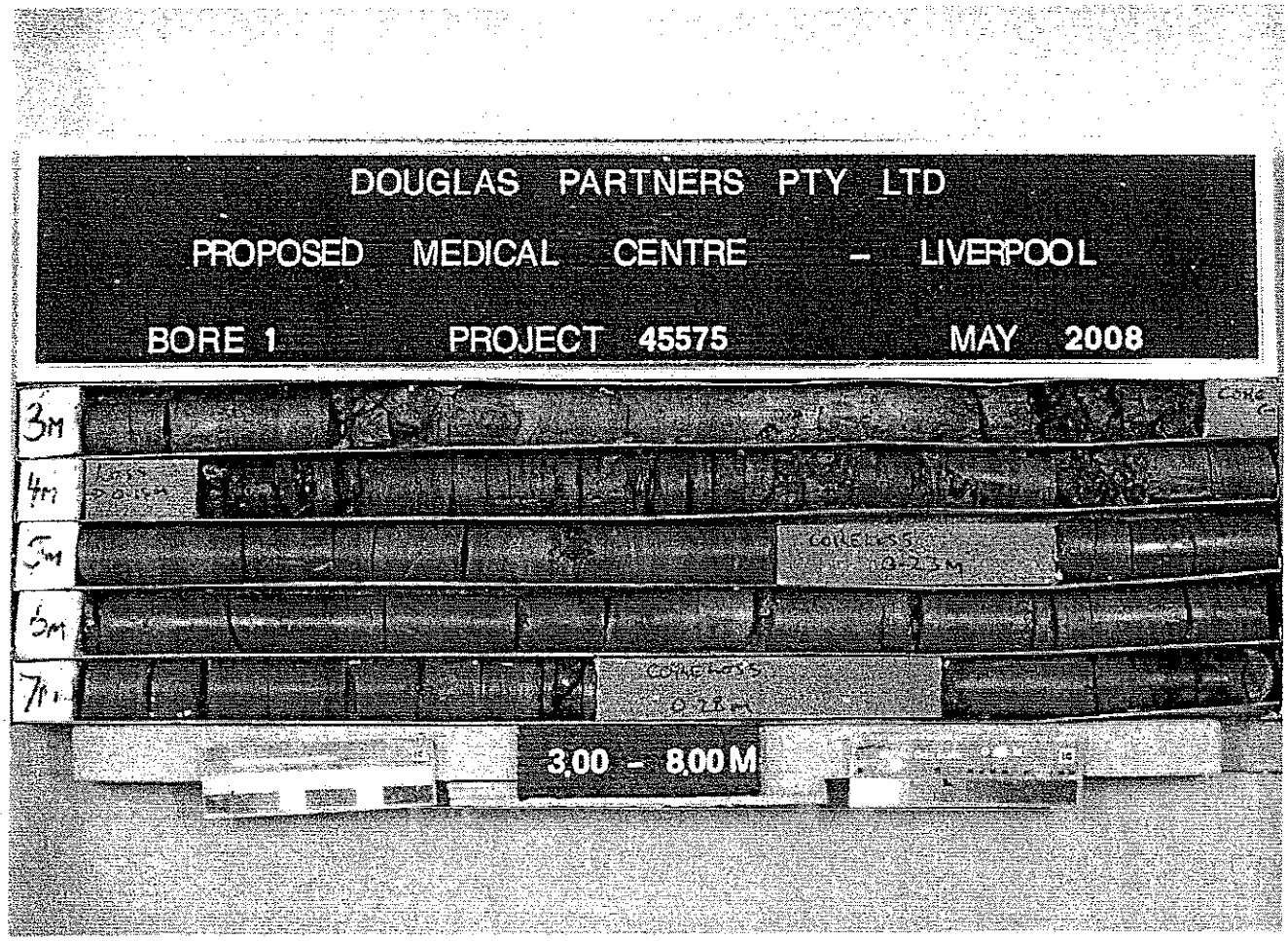
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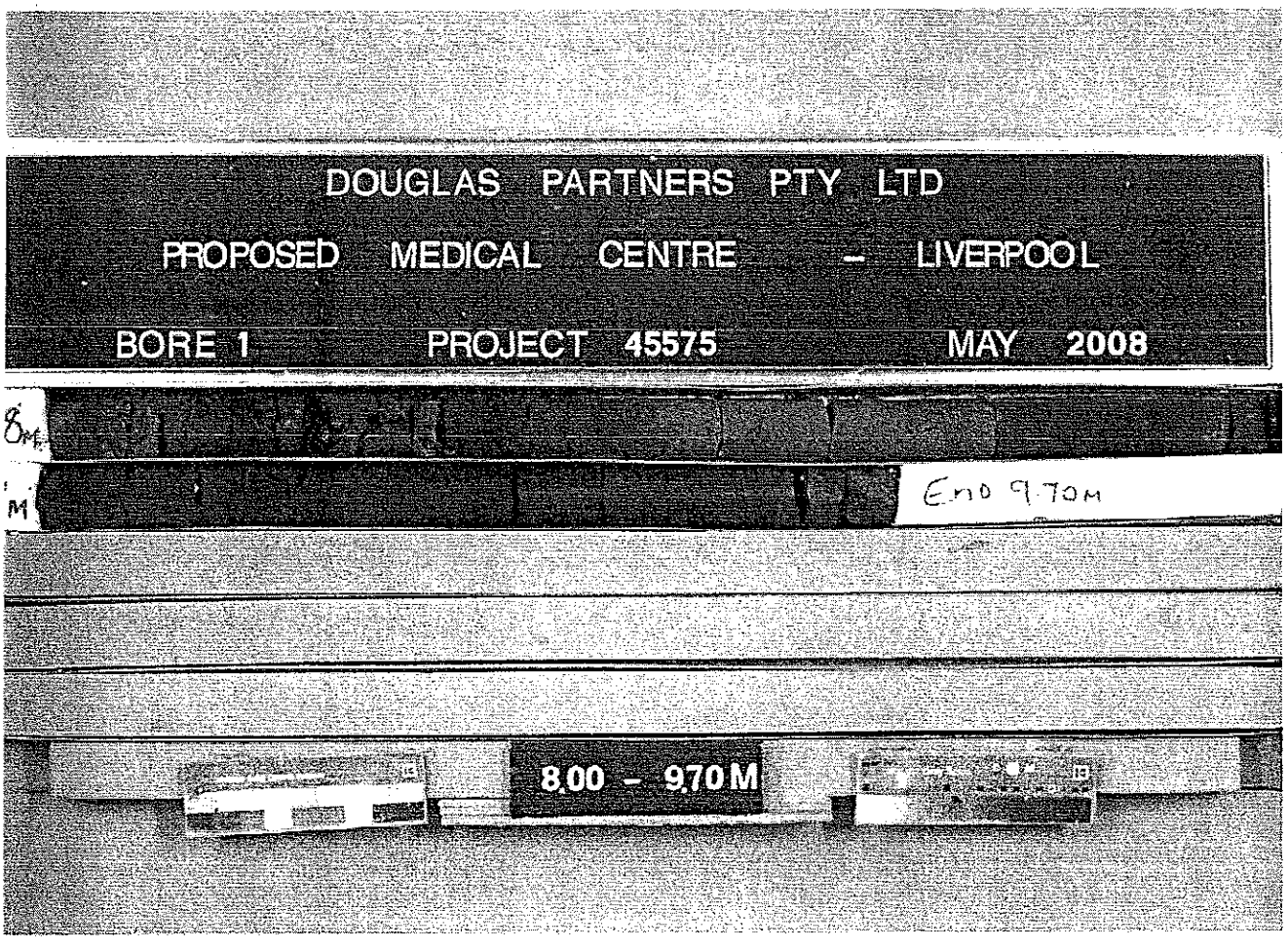
BORE 1 PROJECT 45575 MAY 2008
3M
4M
5M
6M
7M
3.00 - 8.00 M


DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE - LIVERPOOL
BORE 1 PROJECT 45575 MAY 2008
8M
9M
End 9.70m
8.00 - 9.70 M

BOREHOLE LOG

CLIENT: Brown Consulting (NSW) Pty Ltd
PROJECT: Proposed Medical Centre
LOCATION: 26 Bigge Street, Liverpool

SURFACE LEVEL: 12.8
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 45575
DATE: 7-8/5/08
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
12	0.2	TOPSOIL - grey brown silty clay topsoil, with some fine grained sand and plant rootlets, moist							A/E			
	0.6	CLAY - stiff, mottled orange brown, light grey clay, damp							A/E			
11	1	CLAY - very stiff, mottled orange light grey clay with some ironstone gravel							A/E S			5,9,9 N = 18
10	2											
	2.1	SILTSTONE - very low strength, grey brown siltstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	S			9,25/100mm refusal
9	3.0	SILTSTONE - medium then low to medium strength, moderately to slightly weathered, fractured to slightly fractured, grey brown siltstone							C	89	72	PL(A) = 0.4MPa PL(A) = 0.3MPa
8	4							4.37m: J55°				
	4.7							4.7m: CORE LOSS: 200mm				
7	5											
	5.1	SILTSTONE - medium strength, fresh, slightly fractured and unbroken, light grey to grey siltstone with some fine grained sandstone laminations							C	87	79	PL(A) = 0.8MPa PL(A) = 0.4MPa
6	6											
	7							6.95m: J70°				
	7.2							7.2m: CORE LOSS: 360mm				
5	8											PL(A) = 0.5MPa
	8.0	SILTSTONE - medium strength, slightly weathered and fresh, slightly fractured, grey to dark grey siltstone							C	100	95	PL(A) = 0.5MPa
4	9	8.7-9.1m: carbonaceous shale band						8.77m: J45° 8.87m: J75°				PL(A) = 0.9MPa
		9.35-9.5m: high strength siltstone						9.27m: J30° 9.35m: J60°- 85°, irregular				PL(A) = 0.7MPa
	9.5	CORE LOSS - core left down hole						9.5m: CORE LOSS: 200mm				
3	9.7	Bore discontinued at 9.7m										

RIG: DT 100 DRILLER: L Cooper LOGGED: SI CASING: HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 9.5m

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:
Date: 5/08

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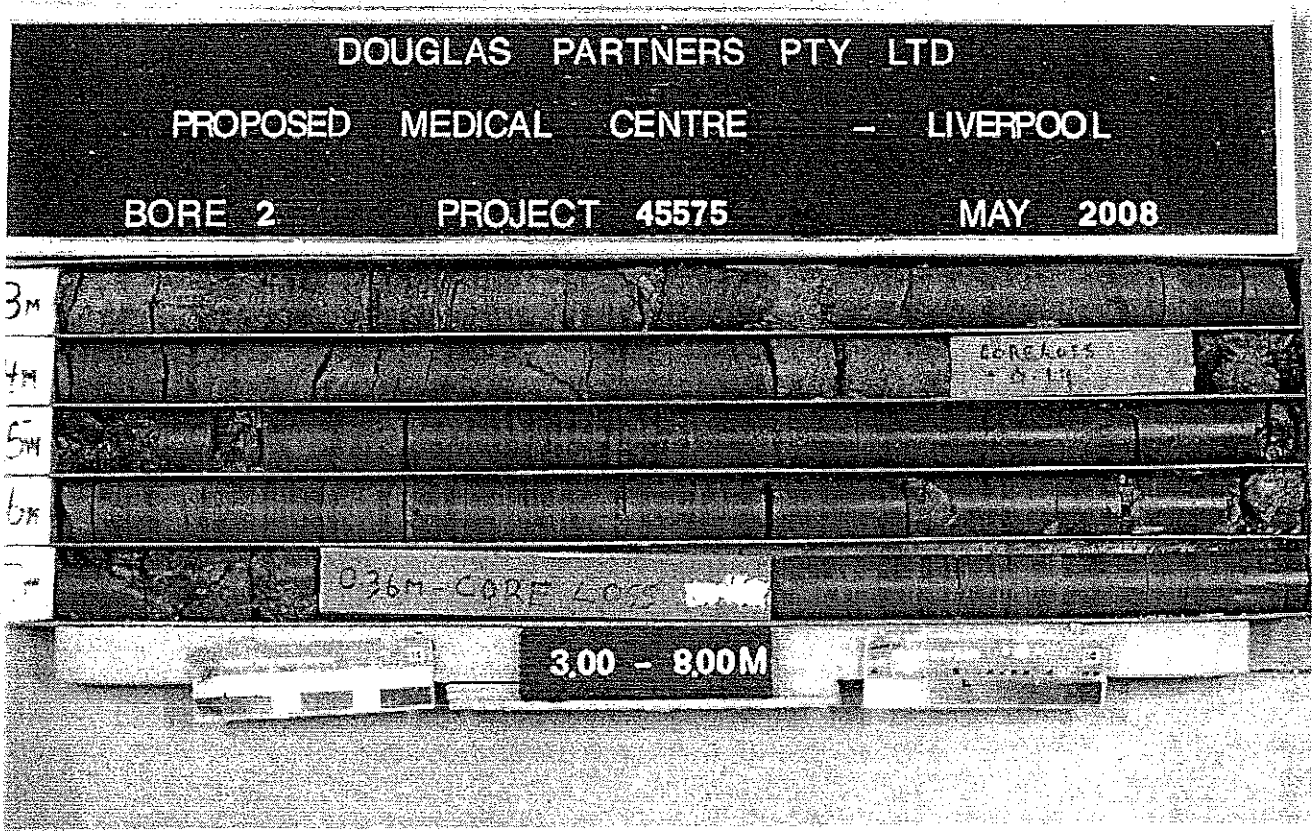
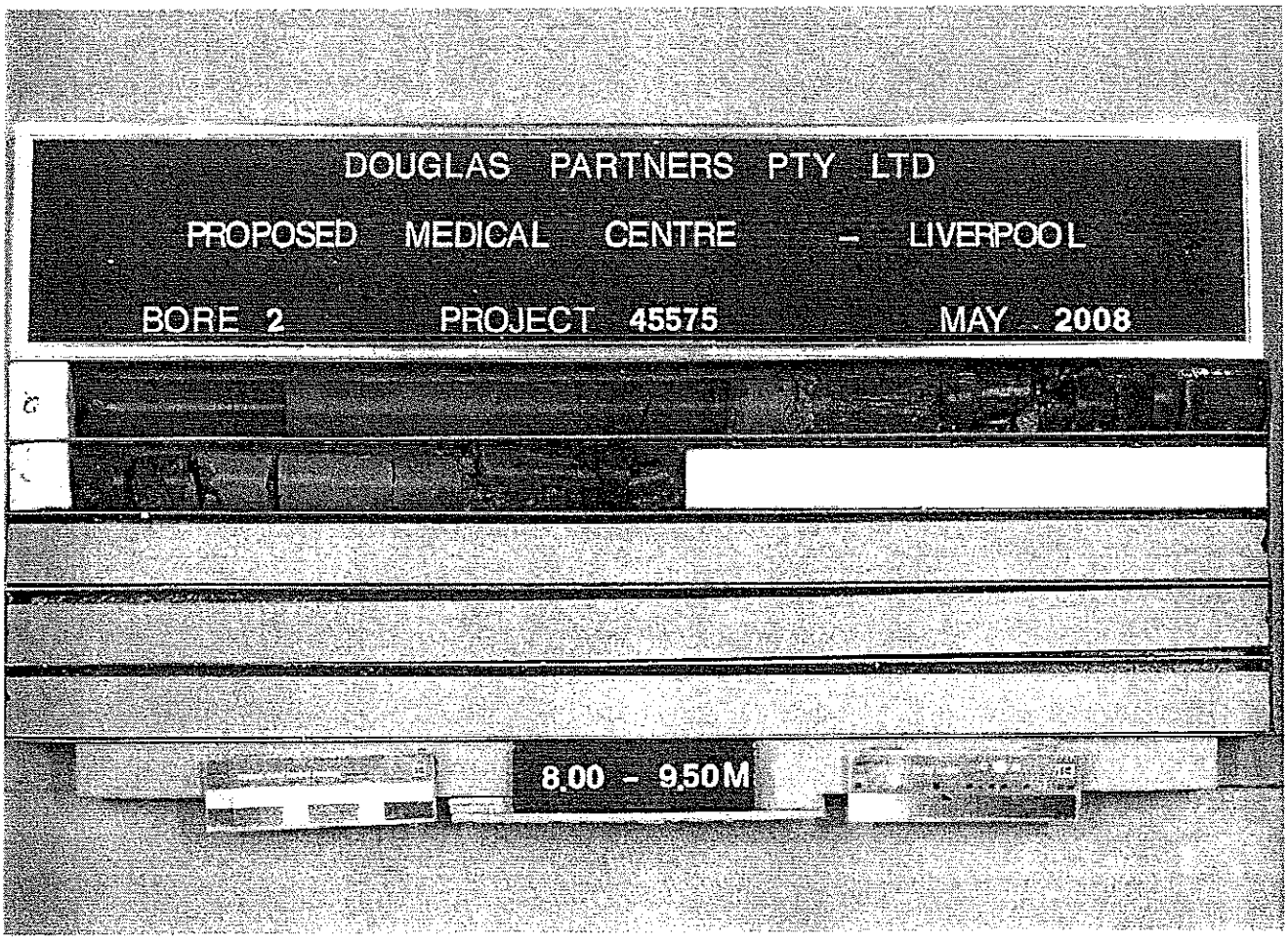

DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 2 PROJECT 45575 MAY 2008
3M
4M
5M
6M
3.00 – 8.00M


DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 2 PROJECT 45575 MAY 2008
8.00 – 9.50M

BOREHOLE LOG

CLIENT: Brown Consulting (NSW) Pty Ltd
PROJECT: Proposed Medical Centre
LOCATION: 26 Bigge Street, Liverpool

SURFACE LEVEL: 12.6
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 45575
DATE: 6-7/5/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ext Low, Very Low, Low, Medium, High, Very High, Ext 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
12	0.2	FILLING - brown silty sand filling with some gravel, humid							A			
	0.5	CLAY - stiff, red brown clay with trace of ironstone gravel, damp							A/E			
11	0.9	CLAY - stiff, light grey clay with trace of silt and ironstone gravel, damp							B			
	1	SILTY CLAY - stiff, mottled orange light grey silty clay, damp							A/E S			8,6,6 N = 12
	2											
10	2.1	SHALY CLAY - hard, grey shaly clay with ironstone bands, damp						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	S			6,12,25/90mm refusal
	3											
	3.0	SILTSTONE - low to medium strength, moderately to slightly weathered, fractured to slightly fractured, grey brown siltstone						3.2m: J35° 3.29m: J50°	C	100	39	PL(A) = 0.3MPa
9	4											
	4.0	SANDSTONE - low to medium strength, moderately to slightly weathered, fractured to slightly fractured, fine grained sandstone with some siltstone laminations						4.15m: J70° 4.31m: J85°				PL(A) = 0.3MPa
8	4.95	SILTSTONE - low to medium strength, moderately to slightly weathered, slightly fractured, grey brown siltstone						4.85m: J90°, clayey 5m: J85° 5.2m: B10°, ironstained 5.28m: J70°, healed 5.36m: J25° 5.48m: J60° 5.8m: J90° 6.4m: J45°- 60° 6.6m: J75°	C	100	80	PL(A) = 0.3MPa
	5											
	6											
7	6.7	SHALE - low strength, slightly weathered, slightly fractured, dark grey shale with medium to high strength band at 7.3m										PL(A) = 0.3MPa
	7							7.3m: J90° 7.85m: J65°	C	100	99	PL(A) = 1MPa
6	7.45	SILTSTONE - medium strength, fresh, slightly fractured, dark grey siltstone										PL(A) = 0.5MPa
	8								C	100	95	
5	9											PL(A) = 0.5MPa
	9.7	Bore discontinued at 9.7m										

RIG: DT 100 DRILLER: L Cooper LOGGED: SI CASING: HQ to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 9.7m

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: TM
Date: 5/08

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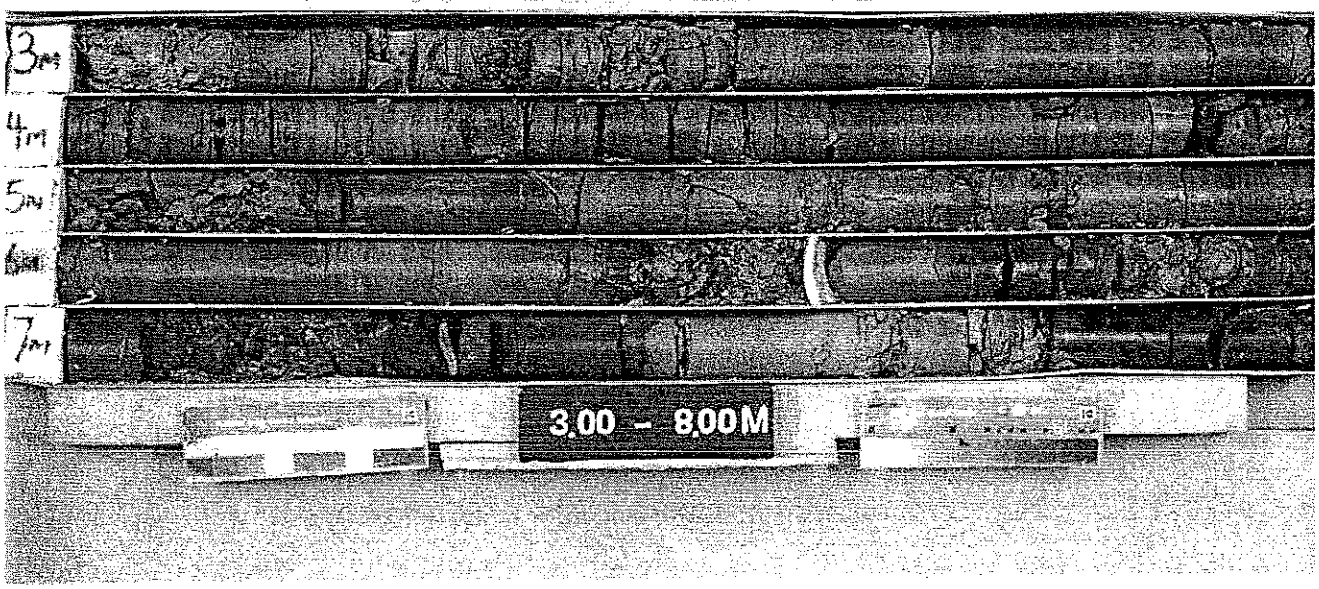
PROPOSED MEDICAL CENTRE – LIVERPOOL

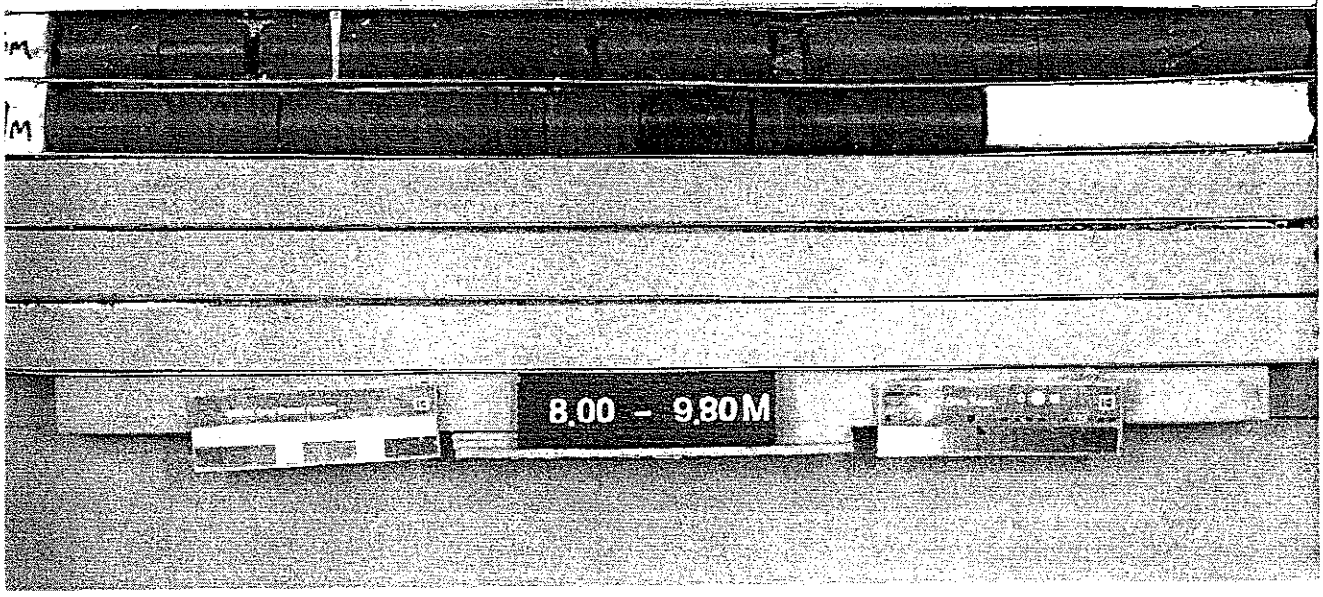
BORE 3 PROJECT 45575 MAY 2008



DOUGLAS PARTNERS PTY LTD

PROPOSED MEDICAL CENTRE – LIVERPOOL

BORE 3 PROJECT 45575 MAY 2008



BOREHOLE LOG

CLIENT:	Brown Consulting (NSW) Pty Ltd	**SURFACE LEVEL:** 12.3	**BORE No:** 4
PROJECT:	Proposed Medical Centre	**EASTING:**	**PROJECT No:** 45575
LOCATION:	26 Bigge Street, Liverpool	**NORTHING:**	**DATE:** 07 May 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
12	0.2	FILLING - light grey silty sand filling with some gravel, humid							A/E			
		FILLING - grey silty clay filling, with some fine sand and gravel, humid							A/E			
	0.7	CLAY - hard, mottled orange light grey clay with trace of ironstone							A/E			
11	1								S			8,16,28 N = 44
	2											
10	2.0	SILTSTONE - extremely low strength, light grey brown siltstone with ironstone bands							S			25,26,28 N = 54
	3											
9	3.1	SILTSTONE - extremely low to very low strength, extremely to highly weathered, light grey and red brown siltstone with medium strength ironstone bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	C	100	0	
	4											
8	4.65							4.65m: CORE LOSS: 50mm				
	4.7	SILTSTONE - low to medium strength, moderately to slightly weathered, slightly fractured, grey brown siltstone with some sandstone laminations						4.81m: J60°				PL(A) = 0.3MPa
7	5							5.15m: J70°	C	75	65	PL(A) = 0.3MPa
								5.5m: J40°				
	5.77							5.77m: CORE LOSS: 330mm				
6	6.1	SILTSTONE - low to medium then medium strength, slightly weathered then fresh, slightly fractured, grey siltstone						6.47m: J35°				PL(A) = 0.3MPa
	7							6.93m: J45°	C	95	61	
5								7m: J90°				PL(A) = 0.9MPa
								7.2m: J35°				
								7.26m: J90°				
	7.58							7.58m: CORE LOSS: 70mm				PL(A) = 0.8MPa
4	8	SILTSTONE - medium to high then high strength, fresh, slightly fractured, grey siltstone						7.85m: J30°- 85°, curved, healed	C	10	100	PL(A) = 1MPa
	9							9.3m: J85°				PL(A) = 1.1MPa
3	9.7	Bore discontinued at 9.7m										

RIG: DT 100 **DRILLER:** L Cooper **LOGGED:** SI **CASING:** HQ to 3.1m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.1m; NMLC-Coring to 9.7m

WATER OBSERVATIONS:

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:	AT
Date:	5/08

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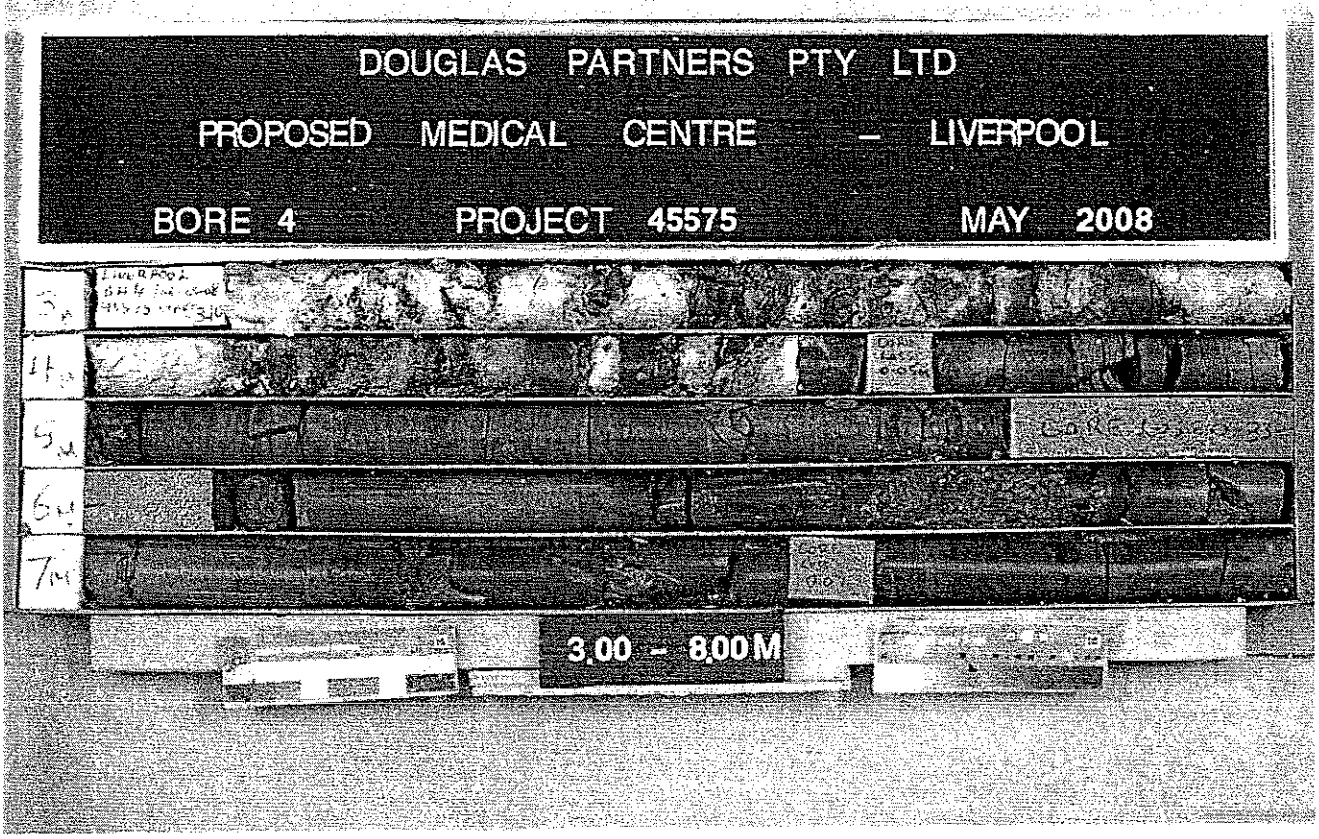
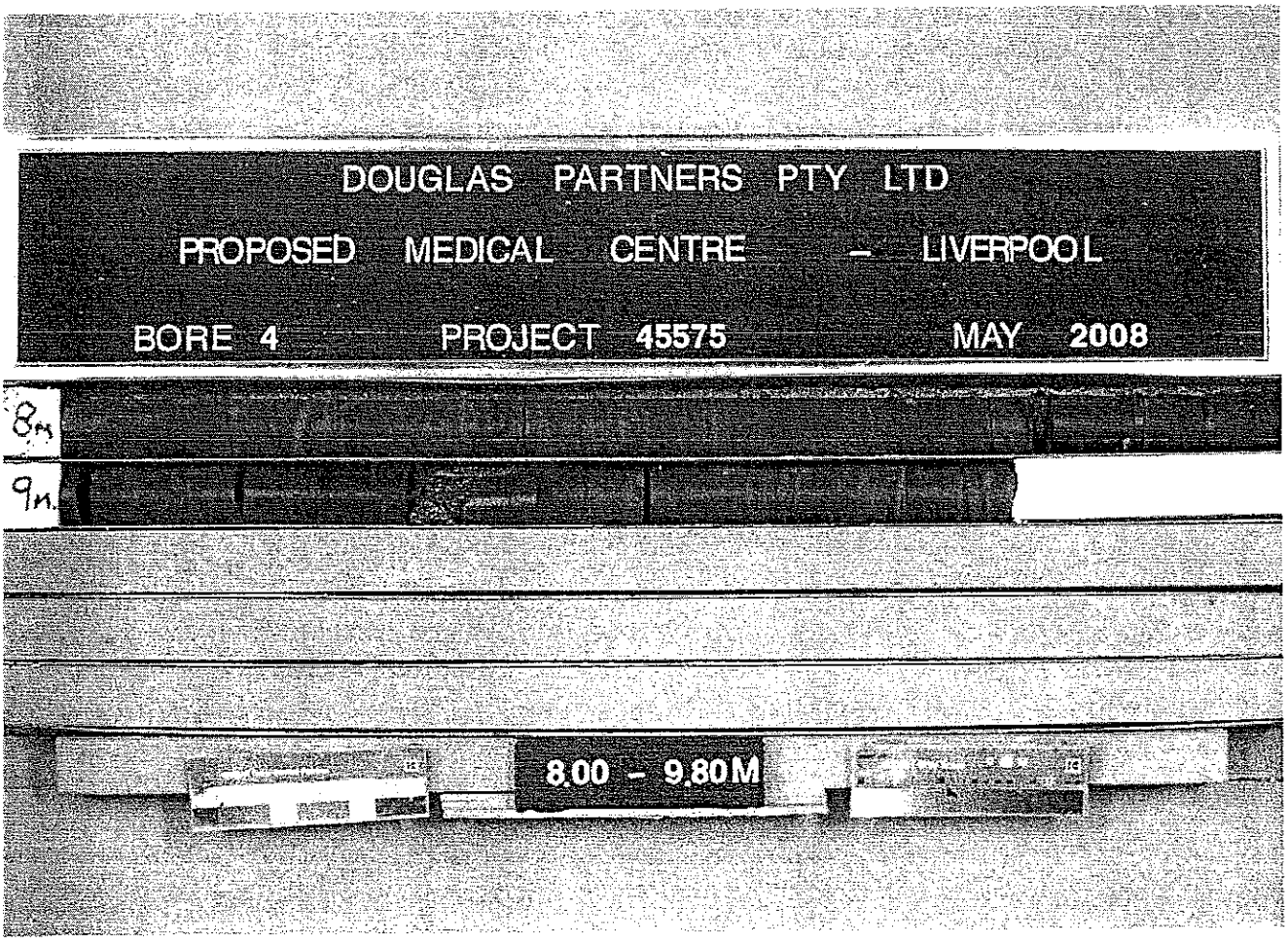

DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 4 PROJECT 45575 MAY 2008
3.00 – 8.00 M


DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 4 PROJECT 45575 MAY 2008
8.00 – 9.80 M

BOREHOLE LOG

CLIENT:	Brown Consulting (NSW) Pty Ltd	SURFACE LEVEL: 12.7	BORE No: 5
PROJECT:	Proposed Medical Centre	EASTING:	PROJECT No: 45575
LOCATION:	26 Bigge Street, Liverpool	NORTHING:	DATE: 06 May 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
12	0.2	FILLING - grey brown silty clay filling, with some fine grained sand and gravel, humid						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping at 0°- 10°	A/E			
	0.7	CLAY - stiff, mottled red, light grey clay, damp							A/E			
1		SILTSTONE - extremely low to very low strength, light grey brown siltstone							A/E S			38,25/50mm refusal
	1.3	SILTSTONE - extremely low to very low strength, extremely to moderately weathered, light grey and brown siltstone with medium strength, ironstone bands						1.3-3.25m: B0° clayey	C	100	0	
11 2												
10	3.05	SILTSTONE - low to medium strength, moderately to slightly weathered, fractured to slightly fractured, grey brown siltstone with some sandstone laminations						3.13m: J85°				
3								3.25-7.2m: fractured along ironstained fractured planes	C	88	42	PL(A) = 0.3MPa
								3.45m: J45°				PL(A) = 0.3MPa
9 4								3.65m: J50°				
								3.92m: J50°				
	4.45							4.45m: CORE LOSS: 250mm				PL(A) = 0.3MPa
8 5								4.92m: J45°, healed				
								5.1m: J50°- 60° healed				
								5.4m: J35°				PL(A) = 0.3MPa
7 6		5.95-6.15m: medium strength sandstone band							C	100	84	PL(A) = 0.5MPa
								6.4m: J85°- 90°, healed				
	6.6							6.6m: CORE LOSS: 200mm				PL(A) = 0.5MPa
6 7									C	86	30	PL(A) = 0.3MPa
	7.35	SHALE - very low and low to medium strength, highly and slightly weathered, slightly fractured, dark grey carbonaceous shale										
5	8.0	SILTSTONE - low to medium and medium strength, slightly weathered and fresh, light to dark grey siltstone with some carbonaceous shale bands						8.1m: J75°				
								8.2m: J65°- 85°, curved				
								8.35m: J25°				PL(A) = 0.4MPa
4 8								8.56m: J60°				
								8.58m: J35°, healed	C	100	90	PL(A) = 0.9MPa
								8.95m: J45°				
3 9												PL(A) = 0.3MPa
	9.7	Bore discontinued at 9.7m										

RIG: DT 100 DRILLER: L Cooper LOGGED: SI CASING: HQ to 1.0m

TYPE OF BORING: Solid flight auger to 1.0m; Rotary to 1.3m; NMLC-Coring to 9.7m

WATER OBSERVATIONS:

REMARKS: Standpipe installed to 9.7m

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:	
Date:	5/08

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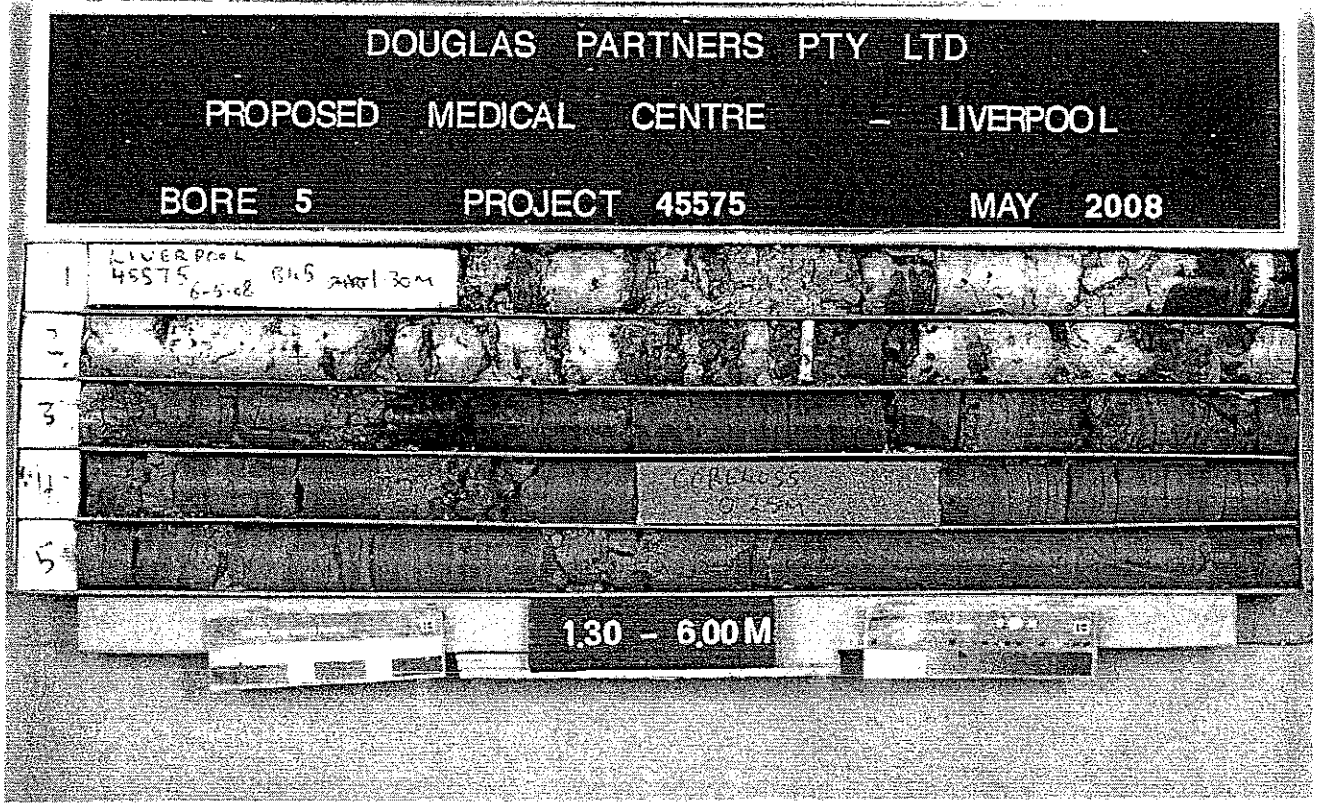
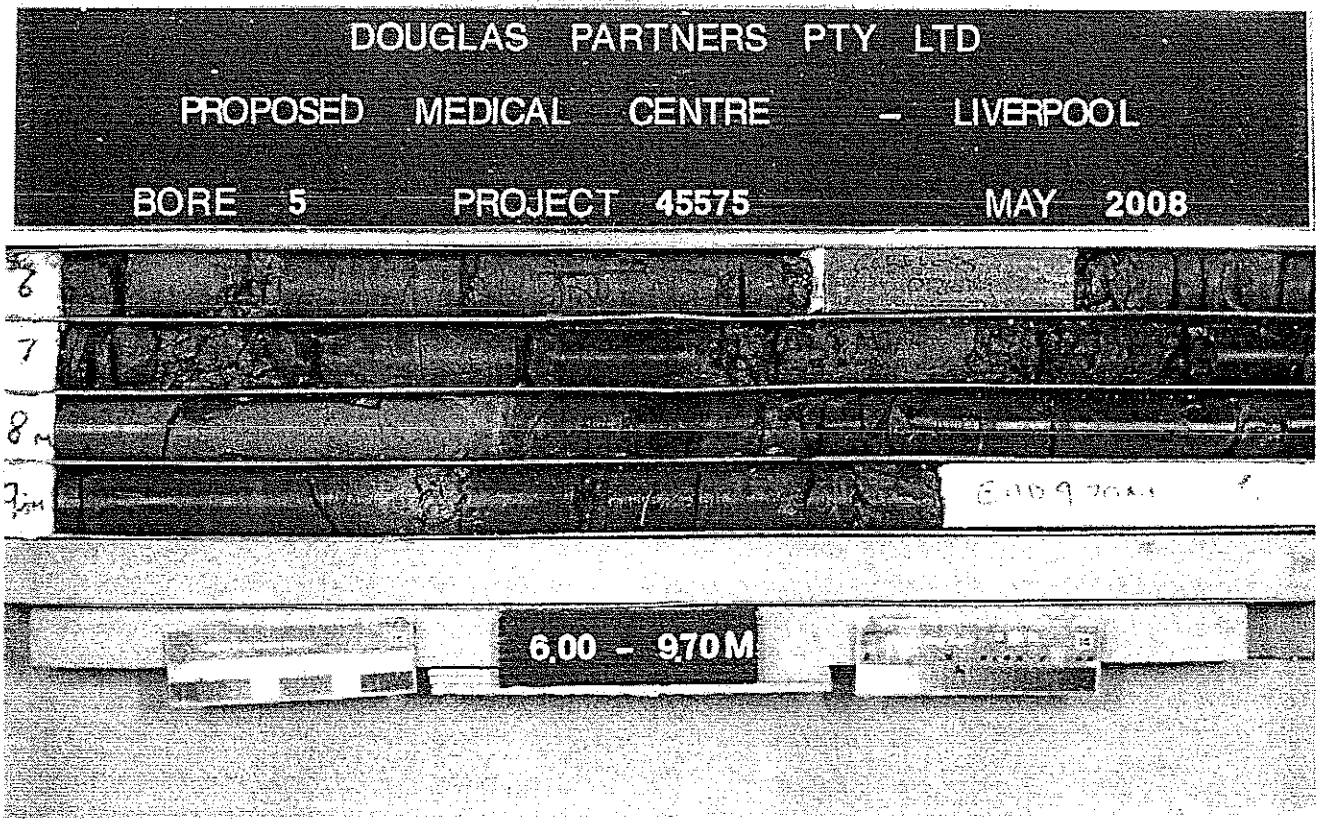

DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 5 PROJECT 45575 MAY 2008
1.30 – 6.00 M


DOUGLAS PARTNERS PTY LTD
PROPOSED MEDICAL CENTRE – LIVERPOOL
BORE 5 PROJECT 45575 MAY 2008
6.00 – 9.70 M

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

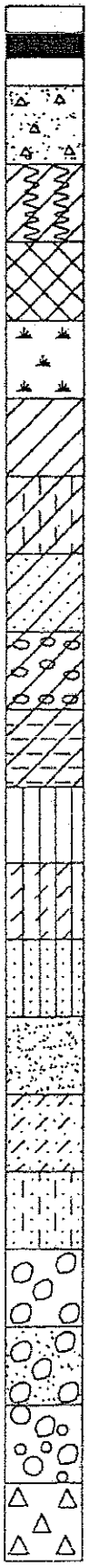
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

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

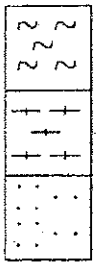


BITUMINOUS CONCRETE
CONCRETE
TOPSOIL
FILLING
PEAT
CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY
SHALY CLAY
SILT
CLAYEY SILT
SANDY SILT
SAND
CLAYEY SAND
SILTY SAND
GRAVEL
SANDY GRAVEL
COBBLES/BOULDERS
TALUS

SEDIMENTARY ROCK

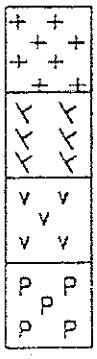
BOULDER CONGLOMERATE
CONGLOMERATE
CONGLOMERATIC SANDSTONE
SANDSTONE FINE GRAINED
SANDSTONE COARSE GRAINED
SILTSTONE
LAMINITE
MUDSTONE, CLAYSTONE, SHALE
COAL
LIMESTONE

METAMORPHIC ROCK



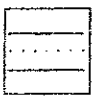
SLATE, PHYLLITE, SCHIST
GNEISS
QUARTZITE

IGNEOUS ROCK

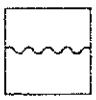


GRANITE
DOLERITE, BASALT
TUFF
PORPHYRY

SEAMS



SEAM >10mm



SEAM <10mm

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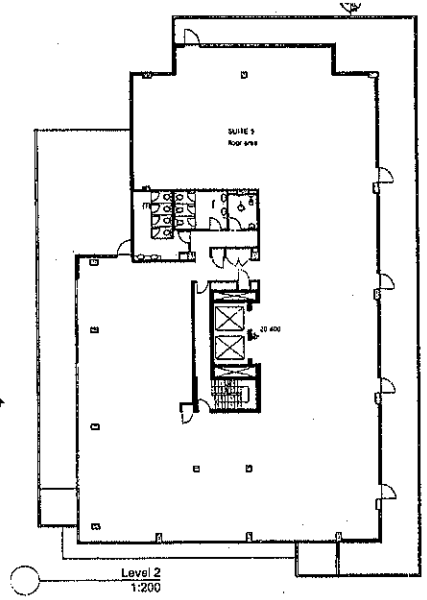
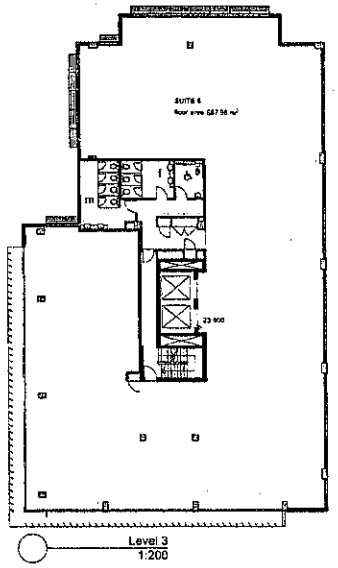
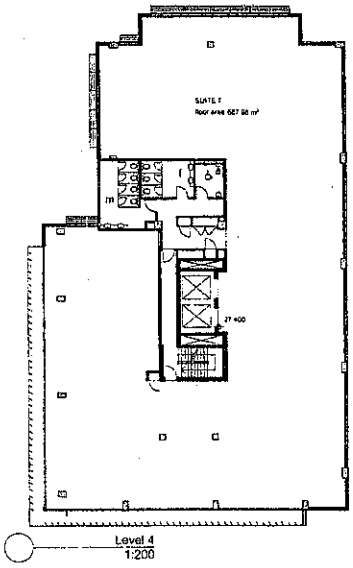
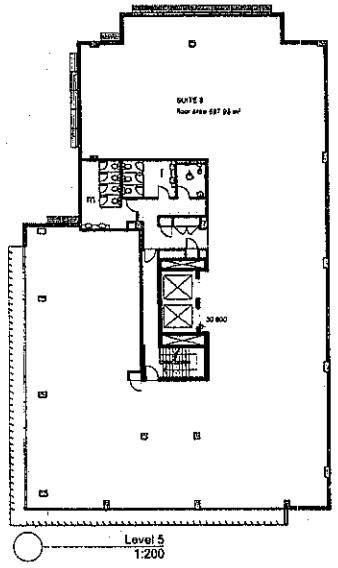
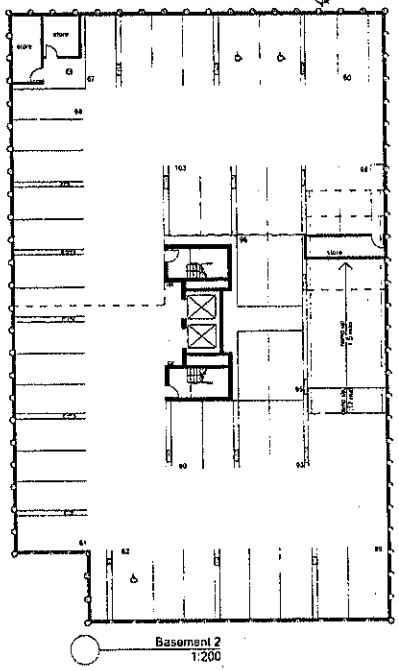
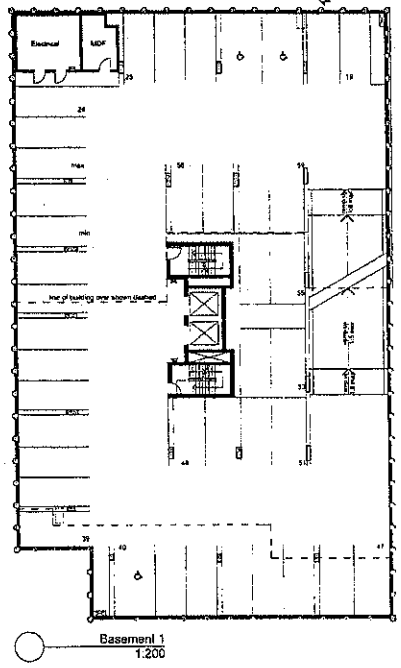


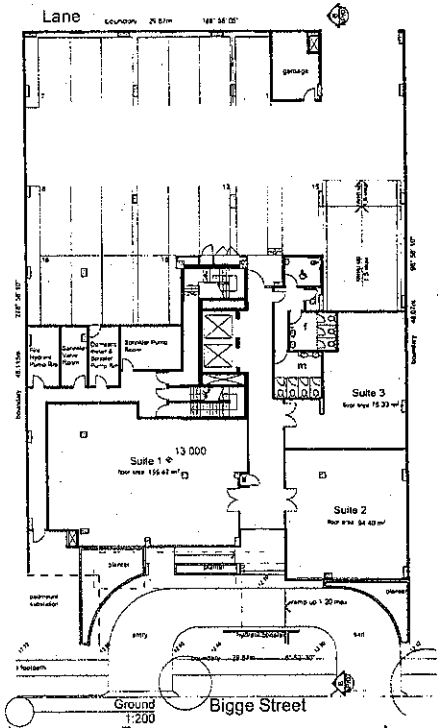


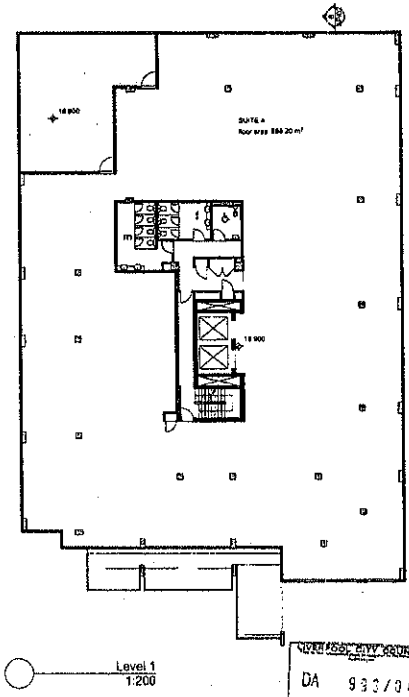












LIVERPOOL CITY COUNCIL
DA 933/04A

Notes

- larger scale drawings and written dimensions take preference
- do not scale from drawing
- all dimensions to be checked on the before commencement of work
- all discrepancies to be brought to the attention of the author

issue	details	by	date
B	SECTION 96 APPLICATION	LD	18.08.06
A	DEVELOPMENT APPLICATION	SS	JULY 06

amendments

project
LIVERPOOL MEDICAL CENTRE

location
26 BIGGE STREET

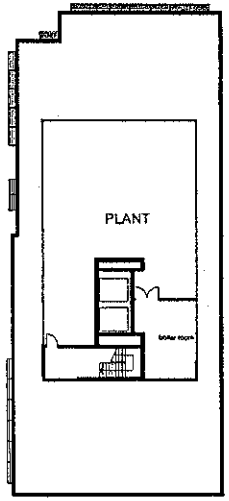
LIVERPOOL

client
KORDAN

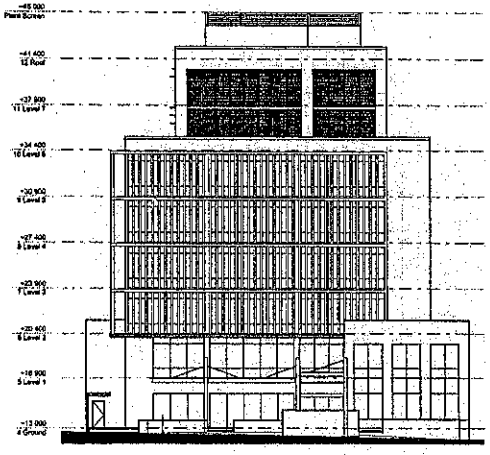
drawing title
Plans

date	checked	project arch	drawn
12.11.06		AD	AD
scale	job no		issue
as shown	08002 AP/01		B

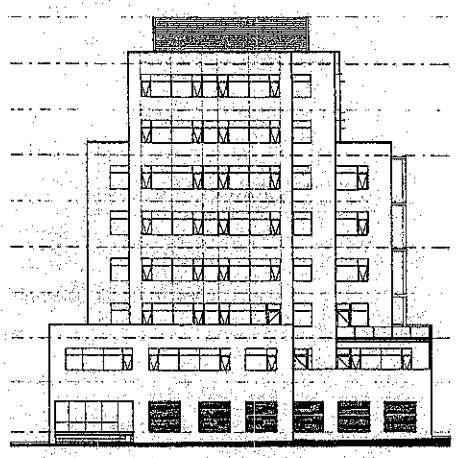
mosca pserras architects
p 02 9601 3244 f 02 9601 6336
a 21 b bathurst street liverpool nsw 2170



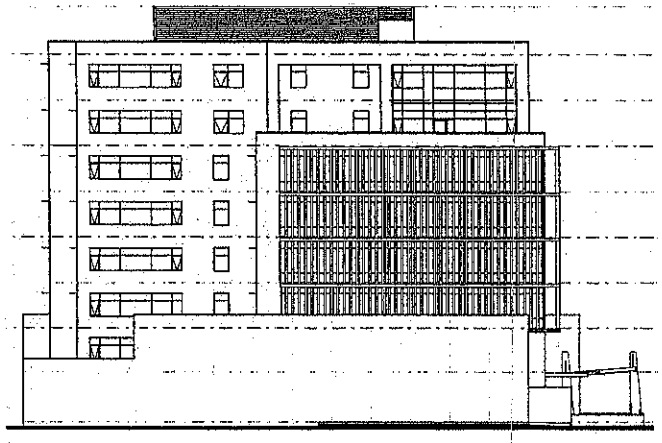
Roof
1:200



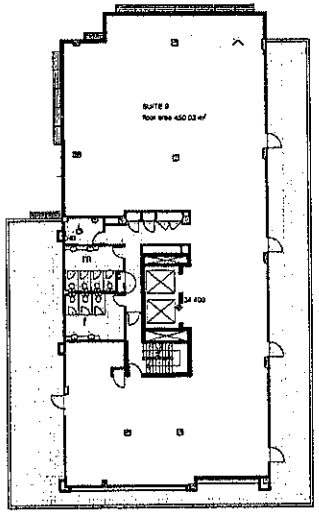
west elevation 1:200



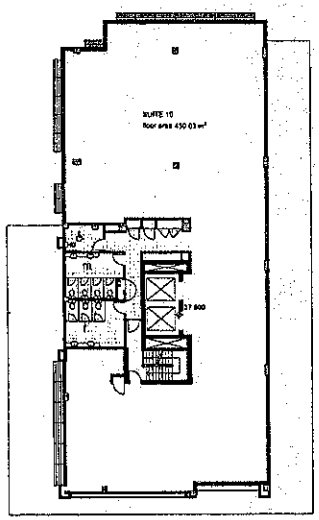
East elevation 1:200



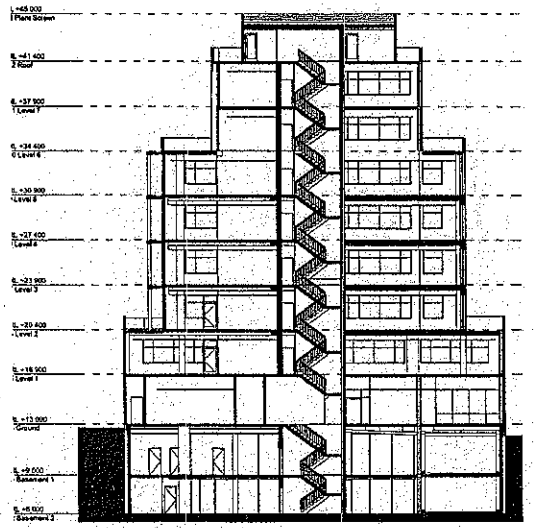
North elevation 1:200



Level 6
1:200



Level 7
1:200



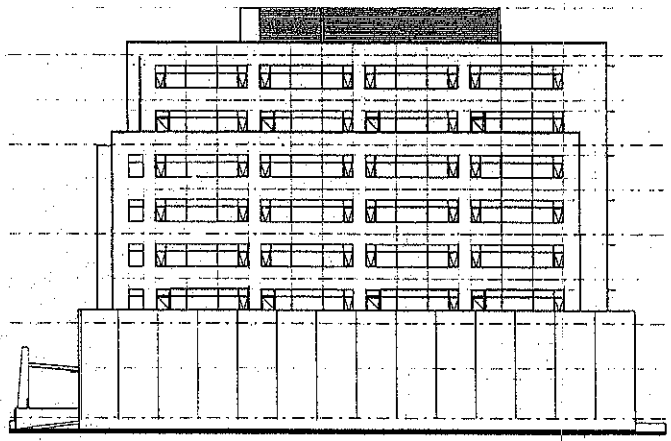
Section A-A
1:200

DATA

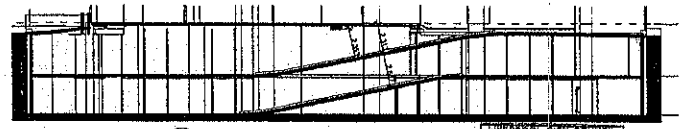
SITE AREA 1438 m²

OFFICE AREA 4066.33 m²
CARPARKING 1/90m²

TOTAL SPACES REQUIRED- 100
TOTAL SPACES PROVIDED- 103



South elevation 1:200



Section B-B
1:200

DA 930/04

Notes

- the drawing is copyright and the property of the author, and must not be retained, copied or used without the authority of mosca pserras architects
- larger scale drawings and written dimensions take preference
- do not scale from drawing
- all dimensions to be checked on site before commencement of work
- all discrepancies to be brought to the attention of the author

issue	details	by	date
B	SECTION 96 APPLICATION	AD	16.06.06
A	DEVELOPMENT APPLICATION	SS	28.11.05

amendments

project
LIVERPOOL MEDICAL CENTRE

location
26 BIGGE STREET

LIVERPOOL

client
KORDAN

drawing title
Plans/ Elevations

date	checked	project arch	drawn
10.11.05		AD	AD
scale	no		issue
AS SHOWN	08002 AP/02		B

mosca pserras architects
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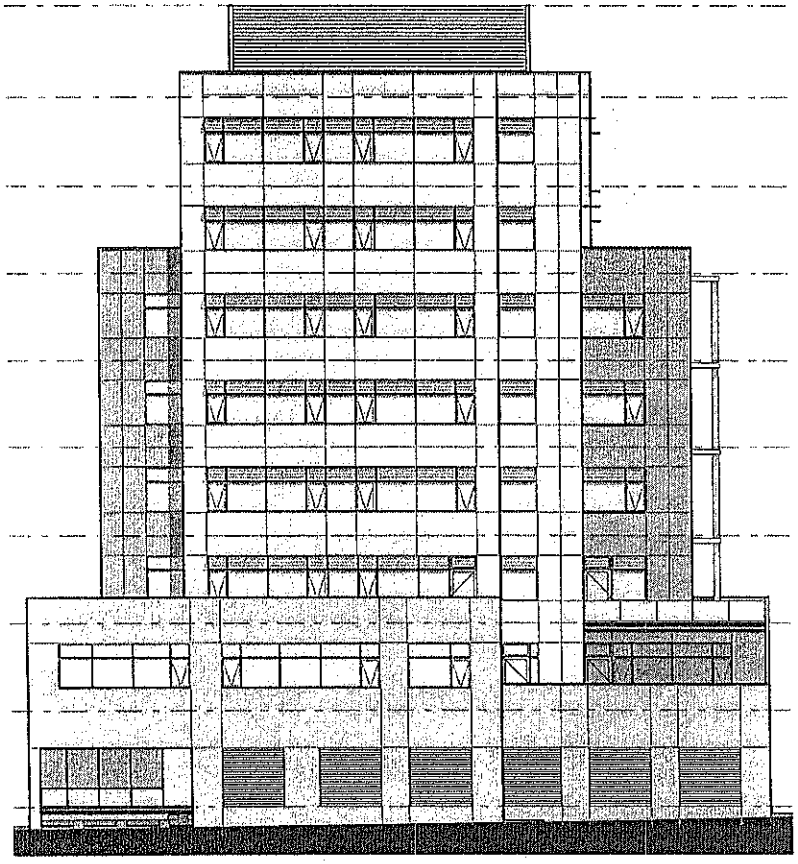
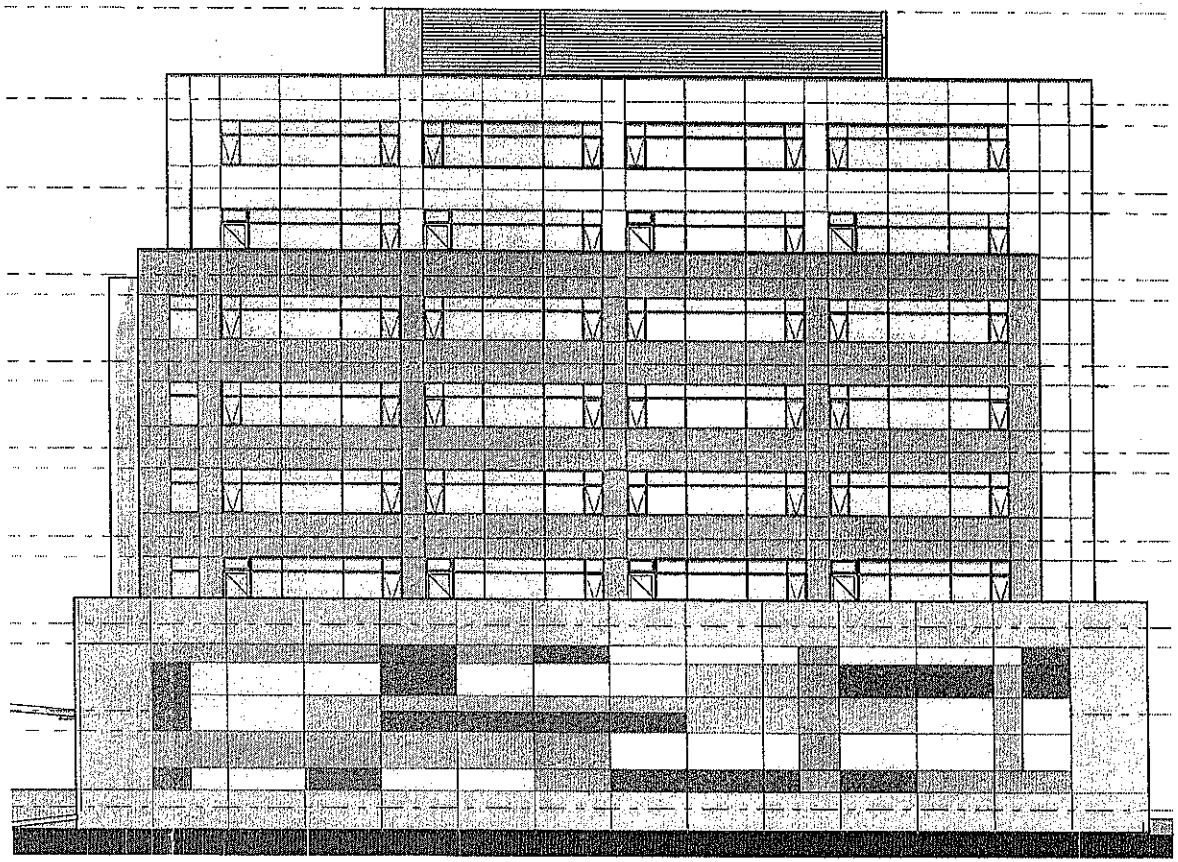
a 21 b bathurst street liverpool nsw 2170



East elevation
1:200



South elevation
1:200

SCHEDULE OF EXTERNAL FINISHES

ALUMINIUM WINDOW AND DOOR FRAMING/ ALUMINIUM LOUVRE/ SUNSHADING DEVICE
DULUX POWDER COAT FINISH-ANOTEC SILVER GREY

9mm COMPRESSED FIBRE CEMENT CLADDING
WITH EXPRESSED JOINTS AS SHOWN
JAMES HARDIE EXOTEC CLADDING SYSTEM
PAINT COLOUR- WATTYL SOLARGARD " CHINO WHITE"

PRE CAST CONCRETE PANEL / 9mm
COMPRESSED FIBRE CEMENT CLADDING
WITH EXPRESSED JOINTS AS SHOWN
JAMES HARDIE EXOTEC CLADDING SYSTEM
PAINT COLOUR- WATYYL SOLARGARD "COLORBOND- DUNE"

PRE CAST CONCRETE PANEL / 9mm
COMPRESSED FIBRE CEMENT CLADDING
WITH EXPRESSED JOINTS AS SHOWN
JAMES HARDIE EXOTEC CLADDING SYSTEM
PAINT COLOUR- WATTYL SOLARGARD "MARROCAN STONE"

PRE CAST CONCRETE PANEL / 9mm
COMPRESSED FIBRE CEMENT CLADDING
WITH EXPRESSED JOINTS AS SHOWN
JAMES HARDIE EXOTEC CLADDING SYSTEM
PAINT COLOUR- WATTYL SOLARGARD "SATINE"

PILKINGTON LOW E GLAZING
ECLISPE ADVANTAGE- "GREY"

Notes

issue	details	by	date
A	SECTION 96	AD	16.6.05

amendments

project
LIVERPOOL MEDICAL CENTRE

location
26 BIGGE STREET

LIVERPOOL

client
KORDAN

drawing title
coloured elevations 2

date	checked	project arch	drawn
1 apr 05		AS	AS
scale	no		issue
1:200	08002 AP/04		A

mpa
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a 21 b bathurst street liverpool nsw 2170