Douglas Partners
Geotechnics | Environment | Groundwater

Report on
Geotechnical Investigation

AMAN Residential Aged Care Facility
20-21 Boorea Avenue, Lakemba

Prepared for
Lebanese Muslim Association

Project 85919.00
May 2017

Integrated Practical Solutions

Douglas Partners
Geotechnics / Environment / Groundwater

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Reviewer		17 May 2017

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Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken for a residential aged care facility at 20-21 Boorea Avenue, Lakemba. The investigation was commissioned in an email dated 6 April 2017 by Mr Stephen Craig of Impact Group on behalf of the Lebanese Muslim Association and was undertaken in accordance with Douglas Partners' Pty Ltd (DP) proposal SYD170350 dated 27 March 2017.

The project involves the construction of residential aged care facility to accommodate 112 beds with basement car parking. The proposed building is three levels high. At the time of the field work, one and two basement levels were being considered and the recent the design is for a single basement under the eastern section of the building envelope.

A geotechnical investigation was undertaken in May 2017 to provide information on the subsurface conditions on the site and included the drilling of four boreholes, laboratory testing and engineering analysis. Details of all the field work and comments relevant to design and construction are given in this report.

A preliminary contamination and waste classification assessment was carried out concurrently with the geotechnical investigation and is reported separately.

2. Site Description and Geology

The site is irregular in shape with an area of 3 175 m^2 with a typical width of 58 m and an average length of approximately 60 m. The site is currently occupied by a house and warehouse. It is located at the northern end of Boorea Avenue cul-de-sac and bounded by industrial developments to the north and south, residential to the east and a stormwater canal to the west.

The site levels fall approximately 2 degrees at a westerly direction from about RL 19.5 m relative to the Australian Height Datum (AHD) to RL 17.5 m.

Reference to the Sydney 1:100 000 Geological Series Sheet indicates that the site is underlain by Ashfield Shale which typically comprises black to dark grey shale and laminite. The site investigation confirms the geological mapping.

A flooding plan produced by the City of Canterbury Council (now City of Canterbury Bankstown) has the flood level from Salt Pan Creek at RL 18.0 m.

3. Field Work Methods

The field work for the geotechnical investigation included the drilling of four cored boreholes (Bores 2 to 5) at the locations shown on Drawing 1, in Appendix B. (It was proposed to drill five boreholes, however the existing buildings with their contents as well as underground services including high voltage electricity restricted available access.) The boreholes were drilled to depths of approximately 10 m using a truck mounted drilling rig. The boreholes were initially augered and rotary drilled to the top of rock at depths of between 3.2 m to 4.5 m and then advanced using NMLC-sized diamond core drilling equipment to obtain 50 mm diameter continuous samples of the rock for identification and strength testing purposes.

A standpipe was installed in Bore 2 to measure groundwater.

The ground surface levels at the borehole locations were interpolated from the site survey drawing provided (Plan of No20-21 Boorea Ave Lakemba, Job Ref D03800, dated 17 March 2017).

4. Field Work Results

The subsurface conditions encountered in the boreholes are presented in the borehole logs in Appendix C. Notes defining descriptive terms and classification methods are included in Appendix C.

The subsurface conditions encountered in the bores can be summarised as:

- Pavement – Mainly concrete and base to about 200 mm depth;
- Filling – sand, sandy clay and gravel to depths between 0.2 m and 1.0 m;
- Clay – firm to stiff, grey brown clay to depths ranging from 1.8 m to 3.0 m;
- Silty Clay – stiff to very stiff, orange brown silty clay to depths ranging from 2.4 m to 3.6 m;
- Shaly Clay – very stiff to hard, brown and light grey shaly clay in two bores to depths ranging from 3.2 m to 4.3 m; and
- Rock – extremely low strength shale over low to high strength laminate. Medium or high strength laminate was encountered below depths of 4.5 m to 5.5 m. The medium and high strength laminate was generally slightly fractured to unbroken. Some joints, dipping in the range of 45^{o} to 85^{o}, were observed in the core samples.

Table 1 summarises the levels at which different materials were encountered in the cored boreholes.

Table 1: Summary of Material Strata Levels

Stratum	Level of Top of Stratum (m, AHD) in Bores			
	2	3	4	5
Ground Surface	17.7	17.9	17.9	17.9
Firm to Stiff Clay	16.7	17.6	17.3	17.2
Silty or Shaly Clay	15.2	14.9	16.1	15.5
Extremely low strength shale/laminite	13.4	13.6	14.9	14.7
Medium or high strength Laminite	12.2	12.8	13.5	13.0
Base of Borehole	7.6	7.8	7.7	7.7

Free groundwater was observed during augering in two of the bores at depths of 2.2 m (RL 15.7 m) and 2.6 m (RL 15.1 m)

5. Laboratory Testing

Twenty six samples selected from the better quality rock core were tested for axial point load strength index (Is_{50}). The results ranged from 0.2 MPa to 1.5 MPa which correspond to low to high strength rock, respectively. These Is_{50} results suggest an unconfined compressive strength (UCS) in excess of 30 MPa for some of the high strength rock encountered during the investigation.

6. Proposed Development

The project involves the demolition of the existing structures and the construction of a three level residential aged care facility over a single level basement under the eastern section of above ground building. The basement level is given as RL 14.8 m and ground floor level as RL 19.0 m.

The proposed basement is adjacent to the boundary on the southern and eastern side and set back about 5 m from the north-eastern boundary. The western side of the basement is mainly well away from the boundary.

The geotechnical issues considered relevant to the proposed development include excavation, excavation support, groundwater, foundations and earthquake provisions.

7. Comments

7.1 Excavation

Excavation depths for the basement are expected to be of the order of 3.5 m. Following demolition of the existing buildings and pavements, excavation for the single level basement is expected to be mainly in filling, clay, silty or shaly clay with rock encountered near the base of the excavation is some areas. Excavation in filling, soil and extremely low strength rock should be readily achievable using conventional earthmoving equipment such as excavators with bucket attachments.

Based on the bores, some low strength laminate is expected within a 3.5 m deep excavation. The depth to consistent high strength rock was 4.5 m to 5.5 m in the bores, much of which is slightly fractured or unbroken. As the rock levels appear to be rising in an easterly direction, contractors should allow for the possibility of encountering some medium or high strength rock within the basement excavation, especially in the eastern section of the site. The excavation of low strength or better rock will probably require the use of ripping equipment, rock hammers or rock saws.

The use of rock hammers will cause vibration which, if not controlled, could possibly result in damage to nearby structures and disturbance to occupants. It is suggested that vibrations be provisionally limited to a peak particle velocity (PPV) of 8 mm/s at the foundation level of the buildings to protect the architectural features of the building and to reduce discomfort for the occupants. A site specific vibration monitoring trial may be required to determine vibration attenuation once excavation plant and methods have been finalised. The contractor will have to select his equipment carefully so that the equipment used on site to remove the laminite does not exceed the vibrations limits.

7.2 Groundwater

Groundwater was encountered in two of the four bores at depths of 2.2 m (RL 15.7 m) and 2.6 m (RL 15.1 m) which is above the proposed basement excavation level (RL 14.8 m). It is also noted that the 100 year floor level on the site is given as approximately RL 18.0 m which is below the ground floor level of RL 19.0 m.

Allowing for some vertical movements in groundwater levels, it is suggested that the basement is tanked to RL 17 m for long term normal site conditions, not taking into account any flooding. If the basement is to be protected from flooding, then the entire basement should be tanked.

During the construction phase, the groundwater movement through the clayey soil is expected to be relatively low which would be normally controlled by sump and pump methods. The potential inflow should be re-assessed during the excavation phase.

7.3 Excavation Support

7.3.1 General

The overburden and the extremely to low strength rock will need to be battered or supported until the permanent basement walls are constructed.

Where there is adequate space such as the western side of the basement, it may be possible to temporarily batter the sides of the basement excavation at no steeper than 1H:1V. In other areas where the basement is close to the boundary and/or supporting neighbouring structures (e.g. the north-eastern boundary), shoring should be provided. Shoring support should be provided for the full height of the basement excavation.

Soldier piles with reinforced shotcrete panel infills are commonly used to support excavations. The soldier piles would generally be spaced at about 2 m to 2.5 m centres and should be socketed into medium or high strength laminite. Shotcreting should be undertaken in maximum 1.5 m or 2.0 m 'drops' as excavation proceeds to reduce the risk of local slippages and collapse between soldier piles. Temporary ground anchors will be required to prevent excessive lateral deformation of shoring/retaining walls. For the permanent situation, the basement structure usually provides the required lateral support to the perimeter excavation once the temporary anchors are de-stressed.

The shoring piles should be founded within consistent medium and/or high strength laminite. The piling rig used to install the piles must be capable of drilling through the high strength laminite layers.

7.3.2 Design

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface. For a single level basement, it may be possible to design cantilever shoring provided it is not supporting any loading from adjacent structures and some lateral and vertical movement can be tolerated behind the wall. Elsewhere, the shoring will have to be anchored or braced. The lateral pressure behind a cantilever or a single row of anchors is usually designed as a triangular distribution. Table 2 outlines material and strength parameters that may be used for the preliminary design of excavation support structures. Where movement is to be limited, such as on the boundaries or supporting adjacent structure, the at rest coefficient should be used.

Table 2: Typical Material and Strength Parameters for Excavation Support Structures

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)
Filling	18	0.4	0.6
Clay	20	0.3	0.5
Extremely/very low strength shale/laminite	22	0.2	0.3

Lateral pressures due to surcharge loads adjacent ground use and construction machinery should be included where relevant. Hydrostatic pressure acting on the shoring walls should also be included in the design.

Passive pressure of 5000 kPa is suggested for the soldier piles in medium and high strength laminate.

The active and passive pressures should incorporate a suitable factor of safety to limit deflection.

7.3.3 Ground Anchors

Where necessary, the use of declined tie-back (ground) anchors is suggested for the lateral restraint of the perimeter piled walls. Such ground anchors should be declined below the horizontal to allow anchorage into the stronger bedrock materials at depth. The design of temporary ground anchors for the support of pile wall systems may be carried out using the typical average bond stresses at the grout-rock interface given in Table 3.

Table 3: Typical Allowable Bond Stresses for Anchor Design

Material Description	Allowable Bond Stress (kPa)	Ultimate Bond Stress (kPa)
Extremely low to low strength shale/laminite	75 - 200	150 - 300
Medium and high strength laminite	350 - 1000	700 - 2000

Ground anchors should be designed to have an appropriate free length (minimum of 3 m) and have a 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 80% 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 in Table 3 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. 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 site boundaries. In addition, care should be taken to avoid damaging buried services, pipes and subsurface structures during anchor installation.

7.4 Foundations

At the base of the bulk excavation works (approximately RL 14.5 m allowing for the basement slab), the exposed material is expected to range from silty clay to shaly clay to extremely low to low strength shale and laminate. Based on the bores, the depth to rock is generally within 1 m of the basement excavation, however, this may increase in a westerly direction.

There is a section of the building, located to the west of the basement, whose lowest floor level is given as RL 19.0 m which is close to the existing surface level. In order to provide a uniform founding layer for the entire structure, it is recommended that all footings are founded on rock.

In the basement, spread footings (i.e. pad or strip footings) founded on the top of rock could be considered for supporting the proposed building loads. In some cases, this may involve excavating approximately 1 m or more to encounter rock. An allowable bearing pressure for spread footings founded on the top of rock, which is generally extremely to very low strength rock, is 1000 kPa.

Alternatively, piles founded on medium or high strength laminate could be adopted for the structure. The bores encountered medium or high strength laminate at levels ranging from RL 12.2 m to RL 13.5 m. The medium and high strength laminate is considered suitable for an allowable bearing pressure of 4.5 MPa.

As the overburden material is predominately clay, bored piers would be generally suitable. However, water was encountered in some of the bores which suggests that temporary casing may be required in some cases if the holes are affected by water. In addition, water may have to be pumped out of the pile holes before concrete is placed. Other suitable pile types include continuous flight auger (CFA) grout or concrete piles.

All bored piers should be inspected by an experienced geotechnical professional to check the adequacy of the foundation material. CFA piles are considered to be a ‘blind’ pile as the base cannot be observed and therefore the piles should be guaranteed by the piling contractor.

7.5 Seismic Design

In accordance with the Earthquake Loading Standard, AS1170.4, 2007, the site has a hazard factor (z) of 0.08 and a site sub-soil class of shallow soil (Ce).

7.6 Further Testing

The locations of the bores for the investigation were limited by the presence of the buildings, the building contents and underground services. The investigation did indicate that the rock levels are falling in a westerly direction. It may be prudent to drill another bore ort two to determine the level of rock when the buildings are demolished so that pile lengths can be more accurately determined prior to piling.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at 20-21 Boorea Avenue Lakemba in accordance with DP’s proposal SYD170350 dated 27 March 2017 and acceptance received from Impact Group dated 6 April 2017. The work was carried out under DP’s Conditions of Engagement. This report is provided for the exclusive use of Lebanese Muslim Association for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations 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.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report 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 or excavation. 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 and test pits 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 or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements 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.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP 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 conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

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, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report 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. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

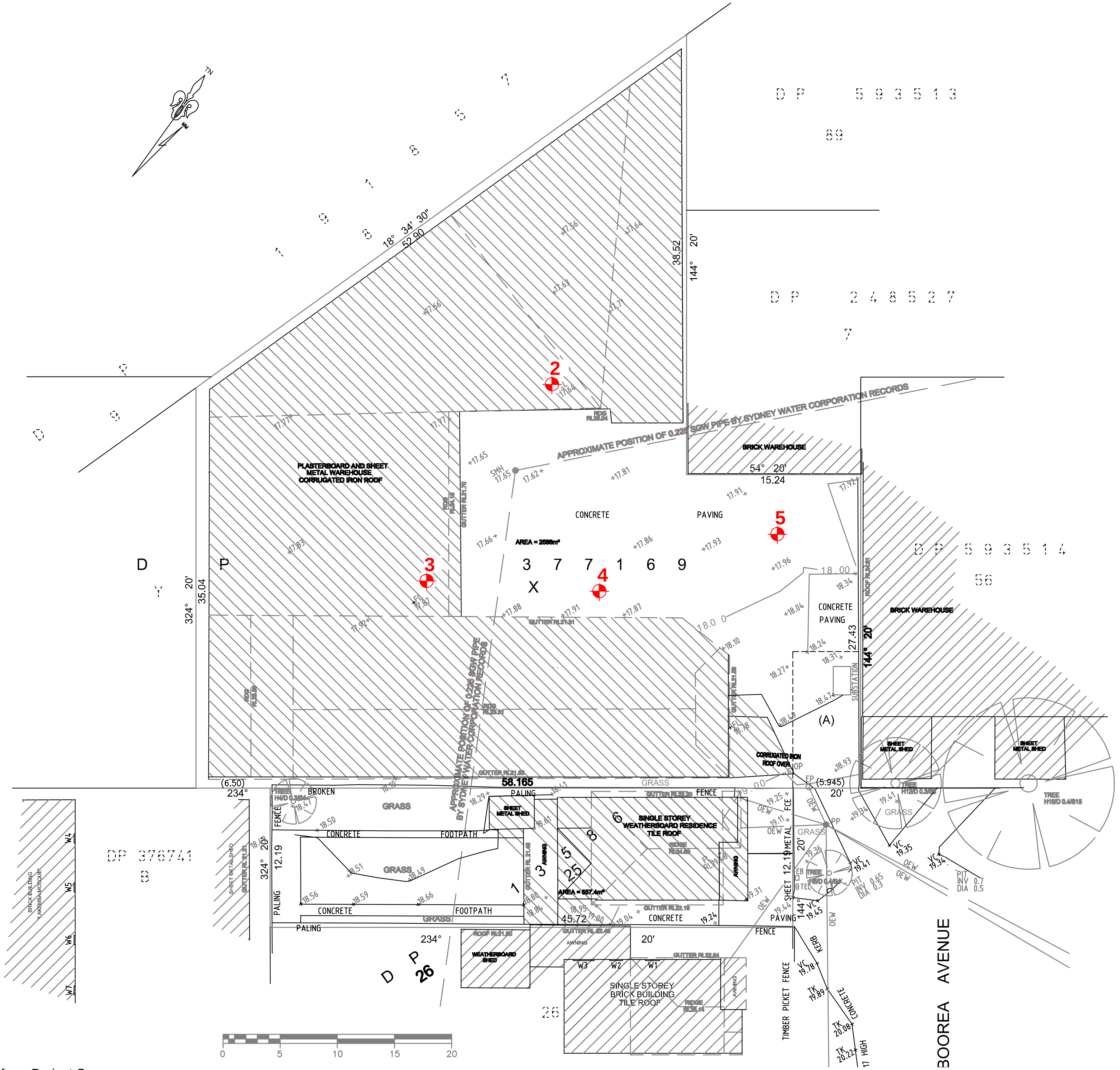
Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental 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

Drawing

Locality Plan



NOTE:
1: Base drawing from Project Surveyors (Dwg D03888-DETAIL, dated 21.3.2017)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND
Borehole location

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lebanese Muslim Association		TITLE: **Location of Boreholes**	PROJECT No: 85919.00
OFFICE: Sydney	DRAWN BY: PSCH	**Aged Care Facility**	DRAWING No: 1
SCALE: 1:400 @ A3	DATE: 12.5.2017	**20-21 Boorea Avenue, LAKEMBA**	REVISION: 0

Appendix C

Borehole Logs

Sampling

Sampling is carried out during drilling or test pitting 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 it to obtain 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.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally 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 samples.

Continuous Spiral Flight Augers

The borehole 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 sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud 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 the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils 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 before the full penetration depth, 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 SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. 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 types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

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

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

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

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General

 Asphalt

 Road base

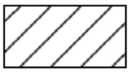
 Concrete

 Filling

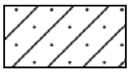
Soils

 Topsoil

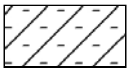
 Peat

 Clay

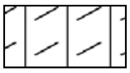
 Silty clay

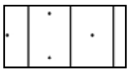
 Sandy clay

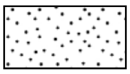
 Gravelly clay

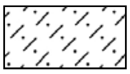
 Shaly clay

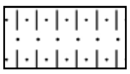
 Silt

 Clayey silt

 Sandy silt

 Sand

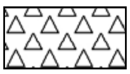
 Clayey sand

 Silty sand

 Gravel

 Sandy gravel

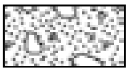
 Cobbles, boulders

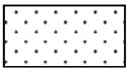
 Talus

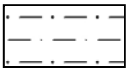
Sedimentary Rocks

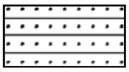
 Boulder conglomerate

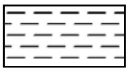
 Conglomerate

 Conglomeratic sandstone

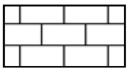
 Sandstone

 Siltstone

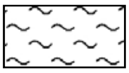
 Laminite

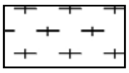
 Mudstone, claystone, shale

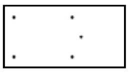
 Coal

 Limestone

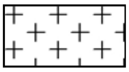
Metamorphic Rocks

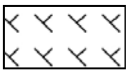
 Slate, phyllite, schist

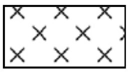
 Gneiss

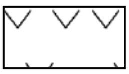
 Quartzite

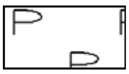
Igneous Rocks

 Granite

 Dolerite, basalt, andesite

 Dacite, epidote

 Tuff, breccia

 Porphyry

BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 85919.00
DATE: 28/4 - 1/5/2017
SHEET 1 OF 2

Depth (m)	Description of Strata	Water	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.13	CONCRETE			A/E			
0.18	ASPHALTIC CONCRETE			A/E			
	FILLING - dark grey sandy clay filling with some roadbase gravel, wet			A/E			
1.0	CLAY - firm to stiff, light grey-brown clay, moist			S			1,2,5 N = 7
				A/E			
2.5	SILTY CLAY - stiff, light brown silty clay, wet	▼		S			6,5,5 N = 10
				E			
3.6	SHALY CLAY - hard, orange-brown shaly clay with ironstone bands, damp		Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			6,14,22 N = 36
4.3	SHALE - extremely low strength, light grey-brown shale/laminite		4.45m: CORE LOSS: 100mm				
4.55							
4.65	LAMINITE - low to medium strength, highly to moderately weathered, fractured, grey-brown laminite with approximately 20% fine sandstone laminations		4.6-4.63m: Cs 4.65m: B0°, cly, 5mm 4.78m: B0°, fe, cly, 10mm 4.93m: J60°, pl, ro, fe 5.06 & 5.10m: B0°, cly, 5mm 5.23m: J, sv, un, ro, fe 5.3-5.46m: B (x3) 0°, fe, cly, 3-5mm	C	96	85	PL(A) = 0.35 PL(A) = 0.96 PL(A) = 0.68
5.5	LAMINITE - medium to high strength, fresh, slightly fractured and unbroken, light grey to grey laminite with approximately 20% fine sandstone laminations		7.16 & 7.46m: B0°, cly co, 1-3mm 8.06m: J, sv, pl, ro, si 8.82-8.83m: fg 9.66-9.67m: fg	C	100	100	PL(A) = 1.01 PL(A) = 1.02 PL(A) = 0.64

Graph columns: Degree of Weathering (EW, HW, MW, SW, FS, FR); Graphic Log; Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High); Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00).

RIG: DT100 **DRILLER:** SV **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Diatube to 0.13m; Solid flight auger to 4.0m; Rotary to 4.45m; NMLC-Coring to 10.1m
WATER OBSERVATIONS: Free groundwater observed at 2.6m whilst augering
REMARKS: Standpipe installed to 10.0m (screen 2.0-10.0m; gravel 1.8-10.0m; bentonite 1.3-1.8m; backfill to GL with gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 85919.00
DATE: 28/4 - 1/5/2017
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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	10.1	Bore discontinued at 10.1m										
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											

RIG: DT100 **DRILLER:** SV **LOGGED:** SI **CASING:** HW to 4.0m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger to 4.0m; Rotary to 4.45m; NMLC-Coring to 10.1m

WATER OBSERVATIONS: Free groundwater observed at 2.6m whilst augering

REMARKS: Standpipe installed to 10.0m (screen 2.0-10.0m; gravel 1.8-10.0m; bentonite 1.3-1.8m; backfill to GL with gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 85919.00
DATE: 27 - 28/4/2017
SHEET 1 OF 2

Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.17	CONCRETE		A/E			
0.27	FILLING - grey sand and roadbase gravel filling		A/E			
	CLAY - firm, light grey-brown clay, moist		A/E			
1			S			1,2,5 N = 7
1.6	SILTY CLAY - stiff, light brown silty clay, moist					
2	2.2m: becoming wet					
			S			3,7,7 N = 14
3.0	SILTY CLAY - stiff to very stiff, light brown silty clay, wet		A/E			
4		Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			5,7,12/60mm refusal
4.3	LAMINITE - extremely low strength, light grey-brown laminite with ironstone bands					
4.55	LAMINITE - low to medium strength, highly to moderately weathered, fractured, grey-brown laminite with approximately 20% fine sandstone laminations	4.55-4.85m: B (x4) 0°- 5°, fe, cly co, 1-5mm 4.85m: J85°, pl, ro, cln 5.03m: B0°, fe, cly, 10mm	C	100	89	PL(A) = 0.26
5.06	LAMINITE - medium then high strength, fresh, slightly fractured and unbroken, light grey to grey laminite with approximately 20% fine sandstone laminations					PL(A) = 0.61
6						PL(A) = 0.66
7		6.94m: B0°, cly, 5mm 7.25-7.27m: fg				PL(A) = 1.14
8			C	100	99	PL(A) = 1.5
9		9.53m: B0, cly, 5mm				PL(A) = 1.17

Water: free groundwater level ▼ at 2.2m.

RIG: DT100 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Diatube to 0.17m; Solid flight auger to 4.0m; Rotary to 4.55m; NMLC-Coring to 10.10m
WATER OBSERVATIONS: Free groundwater observed at 2.2m whilst augering
REMARKS: 30% water loss at 6.7m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 85919.00
DATE: 27 - 28/4/2017
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, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	10.1	Bore discontinued at 10.1m										
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											

RIG: DT100 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Diatube to 0.17m; Solid flight auger to 4.0m; Rotary to 4.55m; NMLC-Coring to 10.10m
WATER OBSERVATIONS: Free groundwater observed at 2.2m whilst augering
REMARKS: 30% water loss at 6.7m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85919.00
DATE: 26/4/2017
SHEET 1 OF 2

Depth (m)	Description of Strata
0.15	CONCRETE
0.17	ROADBASE - gravel and sand filling
0.6	FILLING - grey to dark grey, clay and crushed shale gravel filling, moist
	CLAY - stiff, grey mottled brown clay, moist
1.8	SILTY CLAY - very stiff, orange-brown and light grey, silty clay with ironstone gravel, moist
3.0	SHALE - extremely low strength, grey-brown shale
3.4	LAMINITE - low and very low strength, highly to moderately weathered, fractured, brown laminite with approximately 20% fine sandstone laminations
4.45	LAMINITE - medium and high strength, slightly weathered and fresh, slightly fractured and unbroken, light grey and grey, laminite with approximately 30% fine sandstone laminations

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)

Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°

- 3.48m: B0°, fe, cly, 10mm
- 3.78-4.1m: J, sv (80°-90°), partially he, pl, ro, fe
- 4.12 & 4.17m: J (x2) 55°, pl, sm, ti
- 4.23m: B0°, fe, cly, 5mm; J70°, pl, ro, fe
- 4.43-4.83m: B (x5) 0°, fe, cly co, 1-3mm
- 5.75m: B0°, cly, 5mm
- 8.6m: J30°, pl, ro, cln
- 9.57m: B0°, cly co, 3mm

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			
A			
A			
S			2,4,8 N = 12
S			5,7,10 N = 17
C	100	82	PL(A) = 0.18; PL(A) = 0.68; PL(A) = 0.86
C	100	100	PL(A) = 0.83; PL(A) = 1.28; PL(A) = 1.27
C	100	100	PL(A) = 0.7

RIG: Scout 2 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 3.0m
TYPE OF BORING: Solid flight auger to 3.0m; Rotary to 3.4m; NMLC-Coring to 10.18m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85919.00
DATE: 26/4/2017
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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		LAMINITE *(continued)*							C	100	100	PL(A) = 0.93
	10.18	Bore discontinued at 10.18m										

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19

RIG: Scout 2 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 3.0m
TYPE OF BORING: Solid flight auger to 3.0m; Rotary to 3.4m; NMLC-Coring to 10.18m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 85919.00
DATE: 27/4/2017
SHEET 1 OF 2

Depth (m)	Description of Strata	Discontinuities	Type	Core Rec. %	RQD %	Test Results & Comments
0.13	CONCRETE					
0.25	FILLING - brown clay and roadbase gravel filling		A			
0.7	FILLING - grey silty clay filling with some fine sand and roadbase gravel		A			
	CLAY - firm, brown clay, slightly silty, moist		A			
			S			5,2,3 N = 5
	1.5m: becoming stiff and light brown					
2.4	SHALY CLAY - very stiff, mottled brown-light grey shaly clay, moist	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			7,10,13 N = 23
3.25	LAMINITE - low strength, highly weathered, fractured, brown laminite with some very low strength bands		C	100	90	PL(A) = 0.21
4.25		4.07m: B0°, fe 4.12m: CORE LOSS: 130mm 4.35-4.38m: Cs 4.42-4.46m: Cs 4.5-4.6m: J (x3) 80°, pl, sm, cly 4.59-5.16m: B (x10) 0°, fe, cly co				
4.9	LAMINITE - medium and high strength, slightly weathered then fresh, slightly fractured and unbroken, grey laminite with approximately 25% fine sandstone laminations	5.62 & 3.73m: J (x2) 45°, he 5.92-6.05m: J70°, pl, ro, cln 6.4-6.43m: Sz 6.43m: J90°, pl, ro, cln 6.9-7.1m: J70°, pl, ro, si	C	97	91	PL(A) = 0.84 PL(A) = 0.71 PL(A) = 0.45
		7.13m: J45°, un, ro, cln 7.55 & 7.7m: J, sv, pl, ro, cln 9.75-9.85m: B (x3) 0°, cly co, 2-5mm	C	100	98	PL(A) = 1.47 PL(A) = 0.72 PL(A) = 0.7

Column headings: 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, F - Fault); Sampling & In Situ Testing (Type, Core Rec. %, RQD %, Test Results & Comments)

RIG: DT100 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 3.25m; NMLC-Coring to 10.19m
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Lebanese Muslim Association
PROJECT: AMAN Residential Aged Care Facility
LOCATION: 20-21 Boorea Avenue, Lakemba

SURFACE LEVEL: RL 17.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 85919.00
DATE: 27/4/2017
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, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		LAMINITE *(continued)*							C	100	98	PL(A) = 0.68
	10.19	Bore discontinued at 10.19m										
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											

RIG: DT100 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 3.25m; NMLC-Coring to 10.19m
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
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C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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