Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Supplementary Geotechnical Investigation

Proposed Site 53 Redevelopment
2 Figtree Drive, Sydney Olympic Park

Prepared for
Mirvac Projects Pty Ltd

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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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Report on Supplementary Geotechnical Investigation
Proposed Site 53 Redevelopment
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1. Introduction

This report describes the results of a supplementary geotechnical investigation undertaken for the proposed redevelopment of Site 53 at 2 Figtree Drive, Sydney Olympic Park. The work was undertaken for Mirvac Projects Pty Ltd, developer of the site.

It is understood that the project involves the construction of a multi-storey residential unit building over a common basement. The basement is expected to have up to six levels (lowest level at RL -1.9 m AHD) with localised deeper excavations for footings and lift pits.

The current geotechnical investigation was undertaken to provide additional information on subsurface conditions on the site and included the drilling of cored boreholes, installation of groundwater monitoring wells, laboratory testing and engineering analysis. Details of the field work and comments relating to design and construction are provided in this report.

2. Previous Investigations

Douglas Partners undertook a geotechnical investigation on the site in 2014 (Ref. 73946.00). This investigation was undertake for Mirvac for the current proposed redevelopment. The 2014 investigation was based on a lowest basement level of RL 8.4 m AHD and borehole depths were determined on this basis. The investigation included eight cored boreholes (BH1 to BH8) to depths of 6.2 m to 10.4 m, installation of three groundwater monitoring wells and a preliminary waste classification assessment. The borehole locations are shown on Drawing 1 in Appendix B and the borehole logs are included in Appendix C.

The bores encountered pavement and filling to depths of 0.2 m to 3.2 m. The filling was underlain by residual clays in five of the locations. Shale and laminite bedrock was encountered at depths of between 0.7 m and 4.0 m. The rock was typically weathered near the bedrock surface, becoming medium and/or high strength rock below depths of 1.2 m and 5.0 m.

3. Site Description and Geology

Site 53 is a near rectangular-shaped lot with an area of approximately 1.27 ha. It is bounded by Figtree Drive to the north, Australia Avenue to the east, a pathway and the Sydney Olympic Park railway loop to the south, and commercial premises to the west. The ground surface slopes gently to the south; site levels vary from about RL 20 m AHD in the north-western corner to about RL 12.5 m AHD along the southern boundary.

At the time of the investigation the site was occupied by a commercial building in the northern and eastern portions of the site with on-grade parking areas in the western and southern areas.

The *Sydney 1:100 000 Geological Series Sheet* shows that the site is underlain by Ashfield Shale which typically comprises black to dark grey shale and laminite. Some filling is also expected to be present on the site as a result of previous development activities.

4. Field Work Methods

The current field work included the drilling of eight boreholes (BH101 to BH108) to depths of 15.3 m to 22.0 m using a truck-mounted Scout or DT-100 drilling rig. They were commenced using solid flight augers to drill through the overburden materials and standard penetration tests (SPTs) were undertaken at regular depth intervals. Soon after rock was encountered, the bores were advanced using NMLC-sized diamond core drilling equipment to obtain 50 mm diameter continuous samples of the rock for identification and strength testing purposes.

Groundwater monitoring wells were installed in three of the boreholes (BH101, BH103 and BH108) at the completion of drilling using Class 18 uPVC components. The construction details are provided in the remarks section at the base of the borehole logs.

Rising head permeability tests were conducted in the monitoring wells approximately 1 to 2 weeks after installation. The water within the wells was pumped out and then the rise in the water level was measured at regular intervals as the water level recharged.

The locations of the boreholes are shown on Drawing 1 in Appendix B. The ground surface levels at the bores were measured using a high-precision differential global positioning system (dGPS) receiver.

5. Field Work Results

The subsurface conditions encountered in the current boreholes are presented in the borehole logs in Appendix D together with notes defining descriptive terms and classification methods.

5.1 Boreholes

The materials encountered in the current boreholes can be described as follows:

- FILLING – asphalt and roadbase in the pavement areas, and sandy and clayey filling with silt, igneous and sandstone gravel, concrete, brick, charcoal, shale, sandstone boulders, slag and rootlets to depths of 0.6 m to 4.7 m;
- RESIDUAL SOIL – firm to hard silty clay or shaly clay to depths of 1.2 m to 2.2 m in all bores except BH101, BH102 and BH104, where the filling was directly overlying the bedrock; and

- BEDROCK – laminite and shale below depths of between 0.9 m and 4.7 m to the base of the bores at 15.3m to 22.0 m depth. The rock was typically more highly weathered and extremely low to low strength near the bedrock surface, becoming medium strength and/or high strength rock below depths of 2.9 m to 6.1 m. Numerous steeply dipping joints were observed in the core samples including several fragmented zones.

Free groundwater was not observed during augering and the use of drilling fluid prevented groundwater observations during coring. The water levels were measured in the previous and current monitoring wells 1 to 2 weeks after drilling as outlined in Table 1. It is anticipated that some of the water in the recently installed boreholes was likely water introduced and used for drilling.

Table 1: Groundwater Level Observations in Monitoring Wells

Date	Depth and (RLm, AHD) of Groundwater ()					
	Previous Wells (July 2014)			Current Wells (June 2016)		
	BH1 (8-Jul-14)	BH3 (8-Jul-14)	BH8 (17-Jul-14)	BH101 (7-Jun-16)	BH103 (5-Jun-16)	BH108 (16-Jun-16)
8 August 2014	4.5 (RL15.3)	4.6 (RL9.7)	5.9 (RL7.2)	-	-	-
21 June 2016	Dry to 4.3 (RL15.5) Well blocked	Dry to 4.2 (RL10.1) Well blocked	Dry to 3.5 (RL13.1) Well blocked	8.1 (RL12.0)	4.4 (RL8.9)	2.9 (RL10.3)

5.2 Permeability Tests

Rising head permeability tests were carried out in the monitoring wells in BH101, BH103 and BH108 on 21 June 2016. The results of the tests are included in Appendix D. The monitoring wells were pumped to depths of 12.0 m to 16.2 m and the rise in water levels then measured at regular intervals.

A summary of the results of the permeability testing is outlined in Table 2.

Table 2: Permeability test results

Bore / Well	Well depth (m)	Depth to Water prior to pumping (m)	Depth to Water after Pumping - at Start of Test (m)	Depth to Water at End of Test (m)	Test Duration	Estimated Average Hydraulic Conductivity
BH101	22	8.1	16.2	13.1	26 hours	6.1×10^{-10} m/s
BH103	15.3	4.4	12.0	7.2	25 hours	1.4×10^{-8} m/s
BH108	15.3	2.9	14.3	11.9	25 hours	1.1×10^{-10} m/s

6. Laboratory Testing

6.1 Rock Samples

Rock core samples were tested for axial point load strength index (Is_{50}). The results of the testing are shown on the borehole logs at the appropriate depth. The results generally ranged between 0.2 MPa and 2.8 MPa which correspond to low strength and high strength rock, respectively. Higher Is_{50} values of 3.0 MPa to 6.0M Pa were recorded on very high strength siderite bands. .

6.2 Groundwater Samples

Three groundwater samples were sent to a NATA accredited analytical laboratory and were analysed for a range of potential contaminants to provide preliminary information of groundwater quality. The laboratory test results are included in Appendix E.

7. Geotechnical Model

Geotechnical cross-sections (Section A-A' to Section C-C) showing the interpreted subsurface profile is shown on Drawing 2'to 4 in Appendix B. The sections show interpreted geotechnical divisions of underlying soil and rock together with the current ground surface level and proposed basement level.

It should be noted that the interpreted boundaries shown on the section are accurate at the borehole locations only and layers shown diagrammatically on these drawings are based on inferred strata boundaries. Reference should be made to the borehole logs for more detailed information and descriptions of the soil and rock.

The rock has been classified in accordance with a system developed by Pells et al (1998) which classifies rock strata using a combination of rock strength and fracture spacing to divide the rock into five classes ranging from Class I (high strength and very few defects) to Class V (extremely low to very low strength and/or highly fractured). The interpreted Reduced Level (RL) at the top of the various rock classes is shown in Table 4.

Table 3: Summary of Material Strata Levels and Rock Classifications

Stratum	RL of Top of Stratum (m, AHD)							
	BH101	BH102	BH103	BH104	BH105	BH106	BH107	BH108
Ground Surface	20.1	17.0	13.3	18.8	18.2	13.0	14.4	13.2
Residual Soil	NE	NE	12.7	NE	17.1	12.4	13.7	11.8
Class V/IV Shale	19.2	BE	12.1	NE	16.1	11.7	12.2	11.0
Class III Shale	17.1	12.4	10.3	NE	14.2	9.8	11.4	10.3
Class II/I Shale	15.6	11.6	8.5	14.1	11.4	8.7	8.4	5.8
Base of Borehole	-1.9	-2.0	-2.0	-2.3	-3.1	-2.3	-2.2	-2.1

Notes: Rock classification in accordance with Pells et al (1998); NE = not encountered

A summary of the geotechnical model is described in Table 4.

Table 4: Summary of Geotechnical Model

Geological Unit	Description
Unit A	Sandy and clayey filling with silt, gravel, shale, sandstone, concrete, brick, charcoal, slag and rootlets
Unit B	Residual clay and shaly clay, firm to hard in consistency
Unit C	Class V/IV shale/laminite of extremely low/very low strength with some higher strength bands
Unit D	Class III shale/laminite of low to medium strength
Unit E	Class II/I shale/laminite of medium and high strength

Groundwater was measured in the monitoring wells on the site between RL8.9 m to RL12.0m. Permeability testing was carried out and indicated that after pumping water from the wells, the water level rose slowly to between RL1.3 m to RL7.0 m after 25-26 hours. Groundwater levels are likely to vary with weather and may temporarily rise during periods of prolonged and heavy rainfall. On-going monitoring of groundwater levels, particularly after heavy rainfall, should continue in order to obtain more information on fluctuations in groundwater levels prior to detailed design.

8. Proposed Development

It is understood that the project involves the construction of a multi-storey residential unit building over a common six level basement. The lowest basement level is RL -1.9 m AHD and will require excavation to depths of about 18 m to 11 m, with the depth of excavation reducing towards the south.

9. Comments

9.1 Excavation

Excavation will be required within filling, residual soils and shale/laminite bedrock. Excavation of soil and extremely low to low strength rock should be achievable using conventional earthmoving equipment, however, the assistance of rock hammering or ripping will probably be required for effective removal of any medium strength ironstone bands within the weathered rock sequence. Excavation of medium to high strength rock may require heavy ripping with a large bulldozer together with the use of hydraulic rock breakers for effective removal of this material. Low productivity should be expected in high strength, unbroken laminite.

The detailed excavation for footings, services and side walls within medium strength or stronger rock will generally require the use of a rotary rock saw or grinder, or hydraulic rock hammers.

The laboratory testing undertaken on the core samples indicates UCS values in excess of 35 MPa for the high strength laminite encountered in the bores, with higher strength siderite bands also encountered. The excavation rate that can be achieved, particularly within medium strength or stronger rock, varies considerably and is dependent upon the degree of jointing in the rock, the rock strength, the type of machinery being used. It is suggested that bulk excavation tenderers be required to make their own assessment of the equipment required to carry out the work. Contractors may inspect the rock core samples at the DP office in West Ryde prior to submitting final tenders (rock cores are generally kept for 6 months after drilling unless longer holding times are requested).

The use of heavy excavation equipment will result in vibrations with the potential to damage nearby structures. It is suggested that a maximum peak particle velocity of 8 mm/s be allowed at the foundation level of the adjacent building to reduce the risk of damage to architectural features and to reduce discomfort to occupants. Vibration monitoring on the adjacent building is therefore suggested during excavation.

9.2 Excavation Support

9.2.1 General

Vertical excavations in filling, soil and weathered rock are unlikely to be stable for any significant period of time. Temporary batters may be feasible in some areas of the site and should be cut no steeper than 1(H):1(V) for depths of up to 3 m. Deeper cuts should incorporate intermediate benches to reduce the overall slope to at least 1.5(H):1(V).

Shoring support will be required in areas where temporary batters are not possible. Soldier pile walls with infill shotcrete panels would be suitable for the site and are typically constructed by installing piles at 2 m to 3 m centres prior to the commencement of excavation works. Excavation is then undertaken and infill panels of reinforced shotcrete are provided at about 2.5 m drops as the excavation proceeds. Temporary ground anchors will be required to provide lateral restraint for the walls until such time as the basement floor slabs have been constructed to prop the walls in the longer term.

Preferably shoring piles should be socketed at least 1 m into rock below the bulk excavation level, including allowances for localised deeper excavations for services, lift pits and footings.

For standard bored piles, allowance should be made for pumping of water from the pile hole prior to pouring concrete, or the use of tremie pour techniques. Suitably sized drilling rigs fitted with rock augers will be required to penetrate medium strength or stronger rock. Thicker bands of very high strength siderite may present difficulties for pile drilling and should be considered by the contractor.

It may also be possible to support the excavation faces using soil nails, rock bolts and/or ground anchors with shotcrete cover. This negates the need for shoring piles but will require significantly more drilling and grouting compared with a soldier pile wall, and can be more time consuming as it may need to be done in a staged manner.

9.2.2 Earth Pressures

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface down to the top of Class III rock. Table 5 outlines material and strength parameters that could be used for the preliminary design of excavation support structures.

Table 5: Material and Strength Parameters for Excavation Support Structures

Material	Bulk Unit Weight (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure (kPa)
Filling	20	0.4	0.6	-
Residual Soil	20	0.3	0.45	-
Class V/IV Rock	22	0.15[1]	0.25[1]	750[2]
Class III Rock	23	0[1]	0[1]	3,000[2]
Class II/I Rock	24	0[1]	0[1]	6,000[2]

Notes: [1] Unless unfavourably jointed; [2] Only below bulk excavation level and where jointing is favourable

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

It is suggested that preliminary design be carried out such that the support system has a factor of safety of 1.1 against sliding along the most unfavourable 45° joint. The support system would typically

comprise anchors spaced over the rock face. These anchors should have their bond lengths behind a line projected at 45° above the bulk excavation level and should provide sufficient force to resist the movement of a wedge of rock projected at 45° from just below the anchor to the ground surface. The frictional resistance of the wedge along the joint may be calculated assuming an angle of friction of 20°. Regular rock-face inspections will be required to determine whether the assumed factor of safety is adequate. Additional anchors may be required to increase the factor of safety if large wedges are observed during excavation.

Rock sockets below the bulk excavation level for the purpose of passive restraint should have a minimum length of two pile diameters below the lowest level of any nearby excavation (including any detailed excavations).

It is likely that shoring of the excavation faces will need to incorporate multiple rows of anchors. The lateral pressure distribution on a multi-anchored or braced wall is complex and for preliminary design purposes a uniform distribution with depth (i.e. rectangular) should be assumed. It is recommended that a proven commercial software package such as WALLAP, FLAC or PLAXIS be used to analyse the shoring system to refine the preliminary design prior to commencement of construction.

Lateral pressures due to surcharge loads from sloping ground surfaces, pavements and construction machinery should be included where relevant. Hydrostatic pressure acting on the shoring walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

9.2.3 Ground Anchors

Where necessary, the use of declined tie-back (ground) anchors is suggested for the temporary lateral restraint of the perimeter piled wall systems. 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 piled wall systems may be carried out using the allowable average bond stresses at the grout-rock interface given in Table 6.

Table 6: Bond Stresses for Anchor Design

Material Description	Allowable Average Bond Stress (kPa)
Class V/IV Rock	100
Class III Rock	250
Class II/I Rock	500

Ground anchors should be designed to have a free length equal to their height above the base of the excavation and minimum 3 m bond length. After installation they should be proof loaded to 125% of the design working load and locked-off at no higher than 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 above assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good anchoring

practice. Careful installation and close supervision by a geotechnical specialist may allow increased bond stresses to be adopted during construction, subject to testing.

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

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

9.2.4 Excavation Induced Ground Movements

There is a possibility that there will be horizontal movements due to stress relief effects. Based on published literature and recent experience, the lateral deflections in Shale/Laminite could be in the order of 0.1 - 0.2% of the excavation height, which corresponds with approximately 11 mm to 36 mm for the 11 m to 18 m depth of excavation.

9.3 Groundwater

9.3.1 Groundwater Seepage

Groundwater was measured within the monitoring wells at RL8.9 m to RL12.0m. Permeability testing in the wells indicates the shale over the tested zone had a relatively low permeability of between 1×10^{-8} m/s to 6×10^{-10} m/s. Some of the measured water within the wells may be associated with perched seepage flowing along the top of the clay and rock surface and through fractures in the rock. Groundwater levels will fluctuate with climatic conditions and are likely to increase following periods of extended wet weather. It is suggested that further groundwater monitoring should be carried out to assess possible fluctuations in the groundwater level.

Groundwater seepage will occur through joints and along bedding planes within the rock exposed in the basement floor and in the basement walls (unless a relatively water tight shoring system is socketed below the basement floor level).

It is not possible to provide an accurate estimate of the seepage quantity that may be expected within the basement based on the available data. This would require large scale packer permeability testing of the rock and pumping tests over a period of several weeks together with further analysis. A more usual approach is to monitor the seepage rates during the excavation to confirm and/or re-assess the proposed sump and pump system capacity over the longer term.

9.3.2 Drained and Tanked Basement Options

The need for ongoing management of groundwater seepage, after construction, will depend on whether the basement is designed as a drained basement or water tight (tanked) basement.

During construction and in the long term, it is anticipated that seepage into the excavation could be controlled by perimeter and subfloor drainage connected to a "sump-and-pump" system. On this basis, a drained basement should be suitable for this site. Generally, water collected from drainage system should be suitable for disposal by pumping to stormwater drains subject to confirmation testing and approval from council.

It is possible that seepage into the basement may give rise to precipitation of red brown iron oxide residue from the groundwater and therefore perimeter and subfloor drains should be designed for easy access to allow for inspection, maintenance and periodic cleaning.

A tanked basement will avoid the need for collection and disposal of seepage after construction, however, the tanked basement is initially more expensive than the drained basement. A tanked basement would need to be designed to resist potential uplift forces on the floor slab and lateral forces on the walls associated with groundwater pressures, for which preliminary design could be based on a groundwater level 2 m above measured levels.

9.4 Foundations

9.4.1 Spread Footings

The bulk excavation works are expected to expose Class II/I rock across most of the site. Spread footings (e.g. pad and strip footings) should be suitable for supporting the proposed structures and could be designed on the basis of an allowable bearing pressure of 3500 kPa in the Class III rock and 6000 kPa in the Class II/I rock, providing significant rock defects are not present within the zone of influence of the footings. If defects are present then specific footing excavations may need to be taken deeper and filled with mass concrete prior to the construction of the actual footing.

The settlement of a footing is dependent on the size of the footing, the load applied and the foundation conditions below the footing. Spread footings designed using the allowable bearing pressures in this report should experience settlements of less than 1% of the footing width upon application of the design load.

Spoon-testing in at least 50% of all footing excavations will be required to check for the presence of defects if a bearing pressure of 6000 kPa is adopted. Spoon-testing should be undertaken below the base of the footings to a depth equal to 1.5 times the footing width. All remaining footings should also be inspected by an experienced geotechnical professional to check the suitability of the foundation material.

9.4.2 Piles

Bored piles used for shoring support, and founded below the bulk excavation level, could also be used to support structural loads where necessary. Piles could be proportioned using the parameters shown in Table 7.

Table 7: Design Parameters for Bored Piles

Material Description	Allowable End-Bearing Pressure (kPa)	Allowable Shaft Adhesion[1] (kPa)
Filling/Soil	0	0
Class V/IV Rock	1000	50
Class III Rock	3500	300
Class II/I Rock	6000	500

Notes: [1] Only below bulk excavation level and only where adequate socket-roughness is achieved

The settlement of a pile is dependent on the size of the pile, the load applied and the foundation conditions below the toe. Piles designed using the information contained in this report should experience settlements of less than a few millimetres upon application of the design load.

All foundation piles should be inspected by an experienced geotechnical professional to check the suitability of the foundation material, the socket roughness and the base cleanliness.

9.5 Seismicity

A Hazard Factor (*Z*) of 0.08 would be appropriate for the development site in accordance with Australian Standard AS 1170.4 – 2007 *Structural design actions – Part 4: Earthquake actions in Australia*. The site sub-soil class would be Class C_e.

9.6 Soil Aggressivity

Aggressivity to steel and concrete piles was assessed using the laboratory test results from the 2014 investigation. The exposure classification for both concrete and steel piles is assessed as being Mild in accordance with Australian Standard AS 2159 – 2009 *Piling – Design and installation*.

9.7 Groundwater Quality

The groundwater laboratory test results have recorded generally low concentrations of contaminants. Notwithstanding, concentrations for VOCs (chloroform, bromodichloromethane, dibromochloromethane and bromoform) and short-chain TRH (likely associated with the chloroform) have been recorded in all samples above laboratory detection limits. Medium- to long-chain TRH and bis(2-ethylhexyl)phthalate was recorded above laboratory detection limits in BH101 only. For disposal to stormwater, commonly laboratory detection limits are adopted as initial screening values in lieu of stated requirements by the relevant authority (SOPA) or as outlined in the *National water quality management strategy (Australian and New Zealand guidelines for fresh and marine water quality* 2000 (ANZECC)). The results for zinc (21-44 µg/L) and copper (2-9 µg/L) slightly exceeded the ANZECC criteria of 15 µg/L and 1.3 µg/L respectively which is relatively common and usually consistent with background levels. The groundwater pH was recorded as 8.0 to 9.3 during sampling which is slightly higher than the usual range of 6.5-8.5 nominated for disposal to stormwater.

Given the results, it is recommended that the water quality requirements for disposal to stormwater should be confirmed with SOPA and the groundwater resampled prior to disposal. Turbidity and pH levels should also be confirmed at this time. Based on the current results, DP anticipates that some form of water treatment may be required prior to disposal of the groundwater to the stormwater system.

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for Site 53, 2 Figtree Drive, Sydney Olympic Park in accordance with DP's proposal dated 18 May 2016 and acceptance received from Mirvac Projects Pty Ltd. The report is provided for the use of Mirvac Projects Pty Ltd for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic 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 limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

This report must be read in conjunction with all of the attached notes and 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 a statement, interpretation, outcome or conclusion given 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 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.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

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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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

Drawings

Locality Plan

NOTE:
1: Base image from Nearmap.com
2: Test locations are approximate only and are shown with reference to existing features.

0 10 20 30 40 50 75 100m

1:1000 @ A3

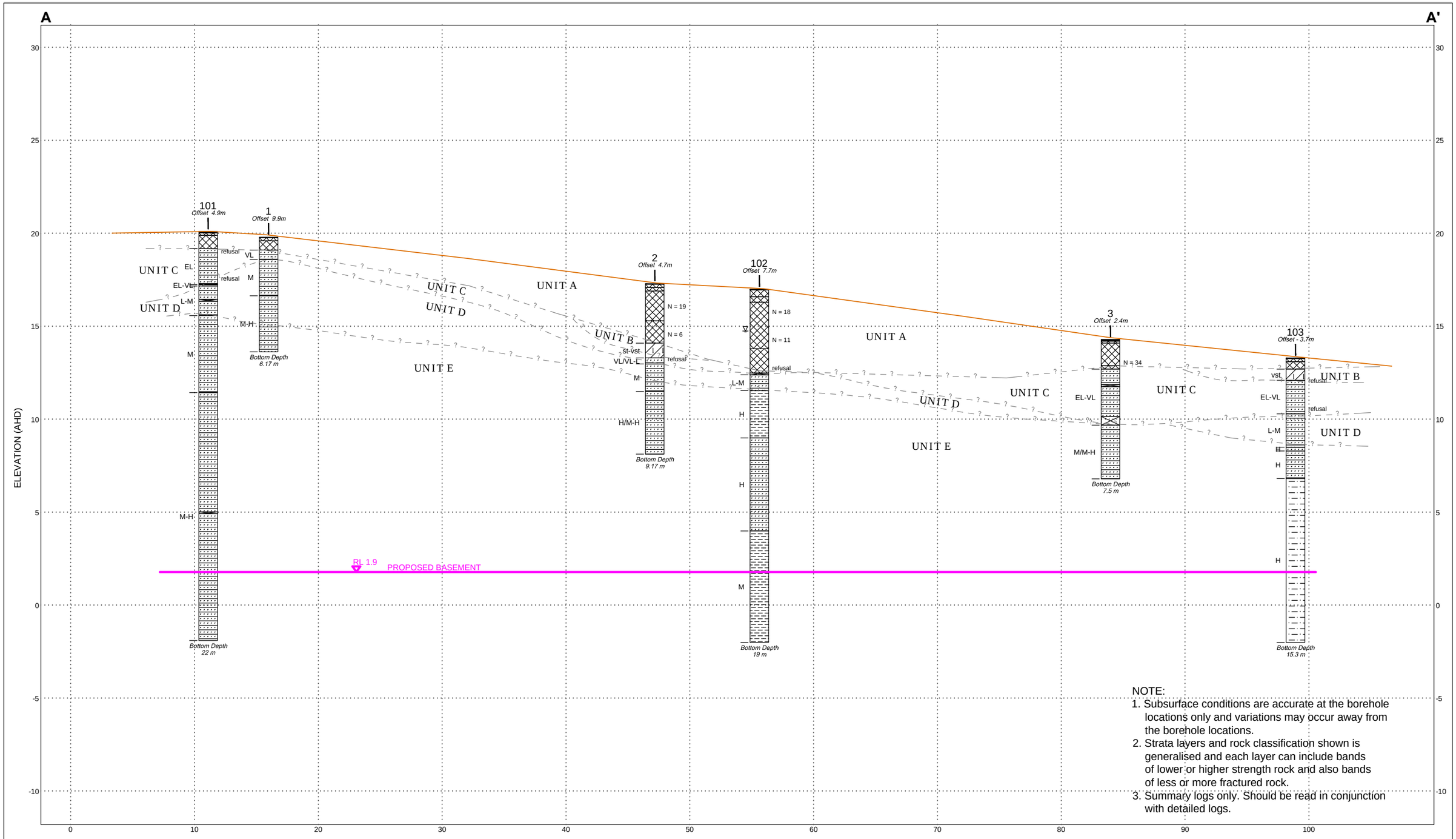
LEGEND

- Borehole - 2014
- Current borehole
- A A' Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Projects Pty Ltd		TITLE: **Borehole Locations**	PROJECT No: 73946.02
OFFICE: Sydney	DRAWN BY: PSCH	**2 Figtree Drive**	DRAWING No: 1
SCALE: 1:1000 @ A3	DATE: 6.7.2016	**SYDNEY OLYMPIC PARK**	REVISION: 0

N



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown is generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Asphaltic Concrete
- Filling
- Laminite
- Shale
- Siltstone
- Silty Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

GEOLOGICAL UNITS:
UNIT A: Filling
UNIT B: Residual Soils
UNIT C: Class V/IV shale/laminite
UNIT D: Class III shale/laminite
UNIT E: Class I/II shale/laminite

0 6
Horizontal Scale (metres)

Vertical Exaggeration = 1.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Projects Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section A-A'**	PROJECT No: 73946.02
OFFICE: Sydney	DRAWN BY: KM/LD	**Proposed Residential Development**	DRAWING No: 2
SCALE: 1:300 (H) 1:200 (V) @ A3	DATE: 23.06.2016	**2 Figtree Drive, Sydney Olympic Park**	REVISION: 0

B

B'

ELEVATION (AHD)

25
20
15
10
5
0
-5
-10
-15

103
Offset - 0.4m
vst
refusal
EL-VL
refusal
L-M
H
H
Bottom Depth
15.3 m

106
Offset - 8.4m
h
N = 49
EL
VL
refusal
L
H
H
Bottom Depth
15;3 m

8
Offset - 5.5m
N = 15
N = 18
vst-h
VL
refusal
VL-L
M-H
H
Bottom Depth
9.65 m

108
Offset 3.7m
N = 6
f-st
VL-L
refusal
M
M-H
M-H
Bottom Depth
15.25 m

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E

RL 1.9
PROPOSED BASEMENT

0
10
20
30
40
50
60
70
80
90
100

DISTANCE ALONG PROFILE (m)

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown is generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Filling
- Laminite
- Shale
- Siltstone
- Silty Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
- Water level

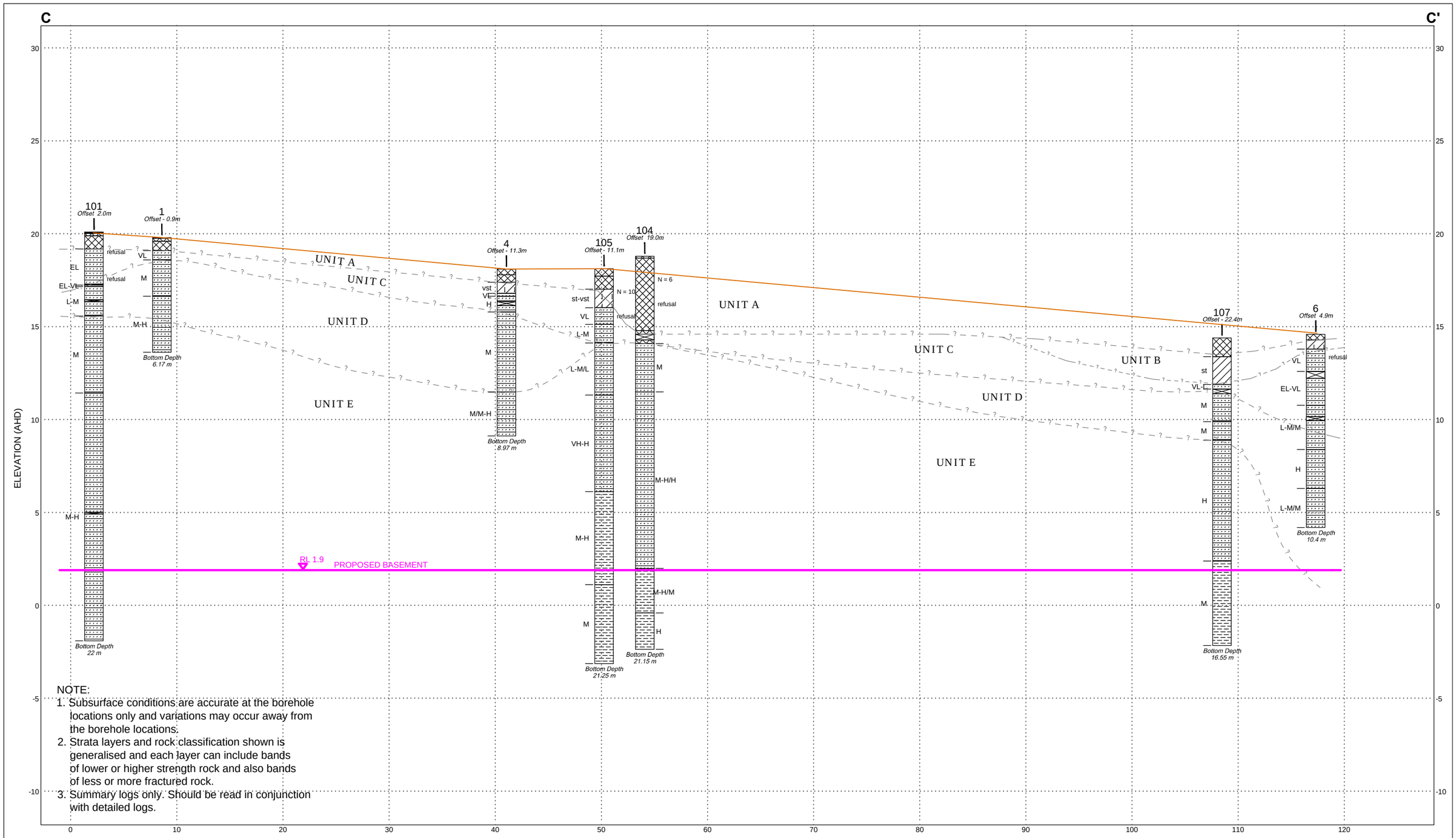
GEOLOGICAL UNITS:
UNIT A: Filling
UNIT B: Residual Soils
UNIT C: Class V/IV shale/laminite
UNIT D: Class III shale/laminite
UNIT E: Class I/II shale/laminite

0 6
Horizontal Scale (metres)

Vertical Exaggeration = 1.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Projects Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section B-B'**	PROJECT No: 73946.02
OFFICE: Sydney	DRAWN BY: KM/LD	**Proposed Residential Development**	DRAWING No: 3
SCALE: 1:300 (H) 1:200 (V) @ A3	DATE: 23.06.2016	**2 Figtree Drive, Sydney Olympic Park**	REVISION: 0



NOTE:

1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown is generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Filling
- Laminite
- Shale
- Silty Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard

TESTS / OTHER
N - Standard penetration test value
- Water level

GEOLOGICAL UNITS:
UNIT A: Filling
UNIT B: Residual Soils
UNIT C: Class V/IV shale/laminite
UNIT D: Class III shale/laminite
UNIT E: Class I/II shale/laminite

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Projects Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section C-C'**	PROJECT No: 73946.02
OFFICE: Sydney	DRAWN BY: ARM/LD	Proposed Residential Development	DRAWING No: 4
SCALE: 1:350 (H) 1:200 (V) @ A3	DATE: 07.07.2016	2 Figtree Drive, Sydney Olympic Park	REVISION: 0

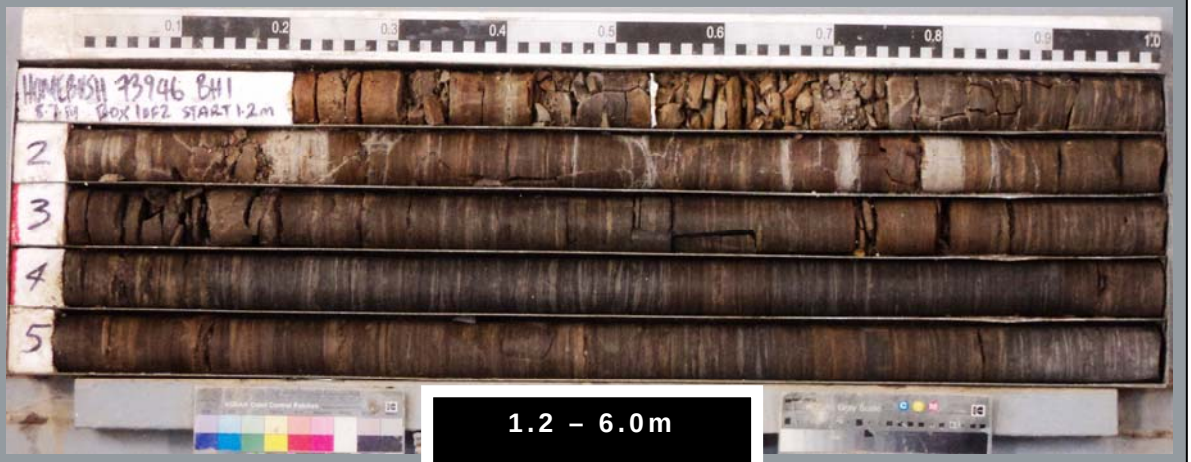
Appendix C

Results of Previous Field Work

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 1 PROJECT 73946 JUL 2014

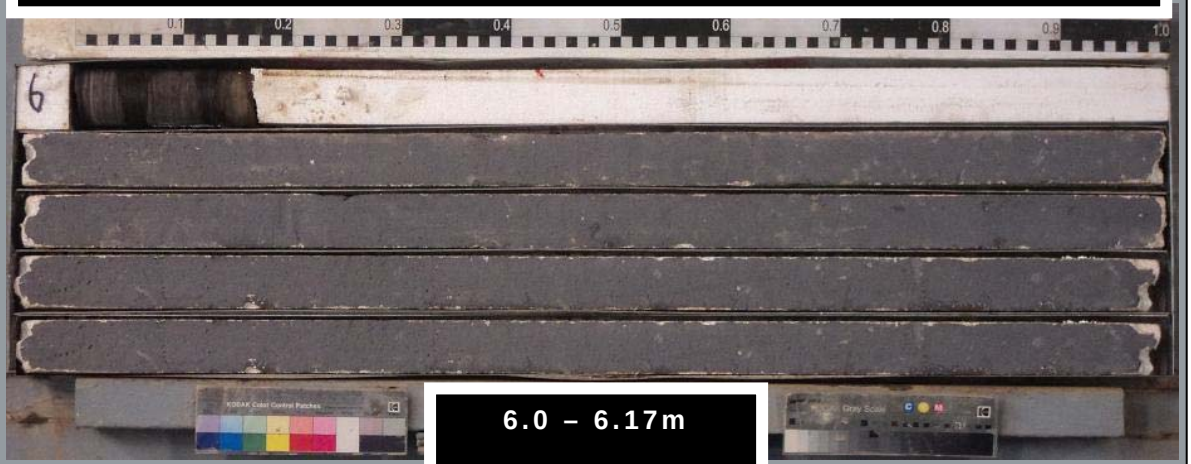


1.2 – 6.0m

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 1 PROJECT 73946 JUL 2014



6.0 – 6.17m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 19.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 73946
DATE: 8/7/2014
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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
19	0.03	ASPHALT						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A/E			
	0.2	FILLING - grey, fine to coarse gravelly silty sand filling, humid							A/E			
	0.7	FILLING - orange-brown, fine to medium sand filling with some silt (ripped sandstone), humid							A/E			
1	1.2	LAMINITE - very low strength, highly weathered, grey and red-brown laminite with some ironstaining						1.2-1.4m: B (x4) 0°, fe,cly	C	100	0	PL(A) = 0.7
18		LAMINITE - medium strength, highly to moderately then moderately weathered, fragmented to fractured, grey-brown laminite with approximately 20% fine sandstone laminations and some clay bands						1.4-1.6m: J, sv (70°-90°) pl, ro, cln 1.54-1.75m: fg, fe 1.75m: J55°, pl, sm, cln & J75°, un, ro, cln 1.9m: J30°, pl, ro, cln 2.06m: J75°, pl, ro, cly 2.18-2.24m: cly 2.24m: J55°, pl, ro, cly 2.34-2.5m: J45° & 90°, st, ro, cln 2.52,2.55 & 2.71m: B's 0°- 5°, cly, 2-10mm 2.75m: J30°- 70°, cu, ro, fe 2.77-2.82m: cly 2.86-2.9m: B0°, cly 3.06m: J55°, pl, ro, cln 3.13m: B0°, cly, 30mm 3.4-3.65m: J85°, pl, ro, cln 3.72 & 3.8m: B0°, fe, cly 3.86-4.16m: B's, 0°, fe, cly 4.6-5.26m: B (x4) 0°, cly 5.35m: J70°, un, ro, fe	C	100	60	PL(A) = 0.4
17												
3	3.15	LAMINITE - medium then high strength, moderately then slightly weathered, slightly fractured, brown then grey-brown, laminite with approximately 25% fine sandstone laminations										PL(A) = 0.5
16												
4												PL(A) = 0.8
15									C	100	85	
5												PL(A) = 0.5
14												
6	6.17	Bore discontinued at 6.17m										PL(A) = 1.3
13												
7												
12												
8												
11												
9												
10												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 1.0m

TYPE OF BORING: Solid flight auger to 1.0m; Rotary to 1.2m; NMLC-Coring to 6.17m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 6.0m (screen 1.0-6.0m; gravel 0.5-6.0m; bentonite to GL; 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)

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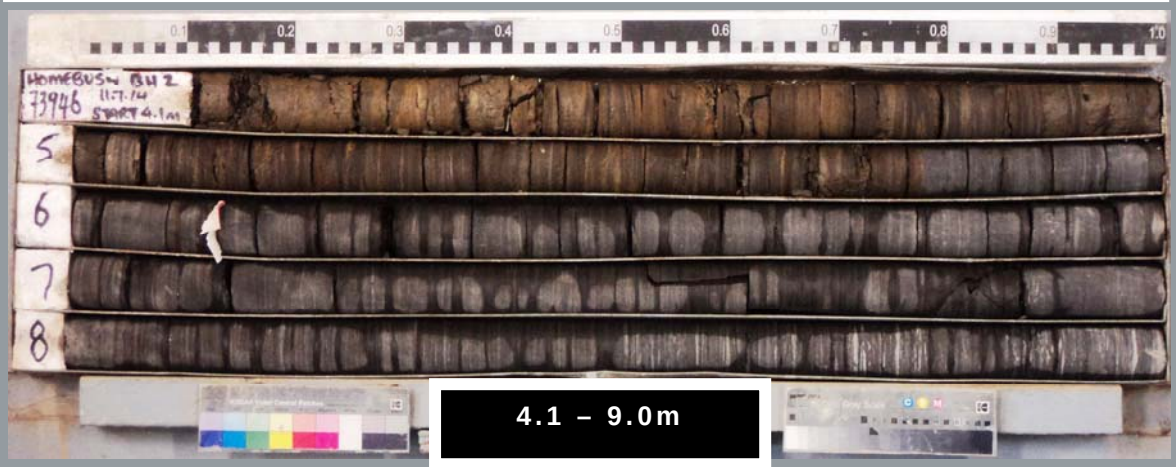
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 2 PROJECT 73946 JUL 2014

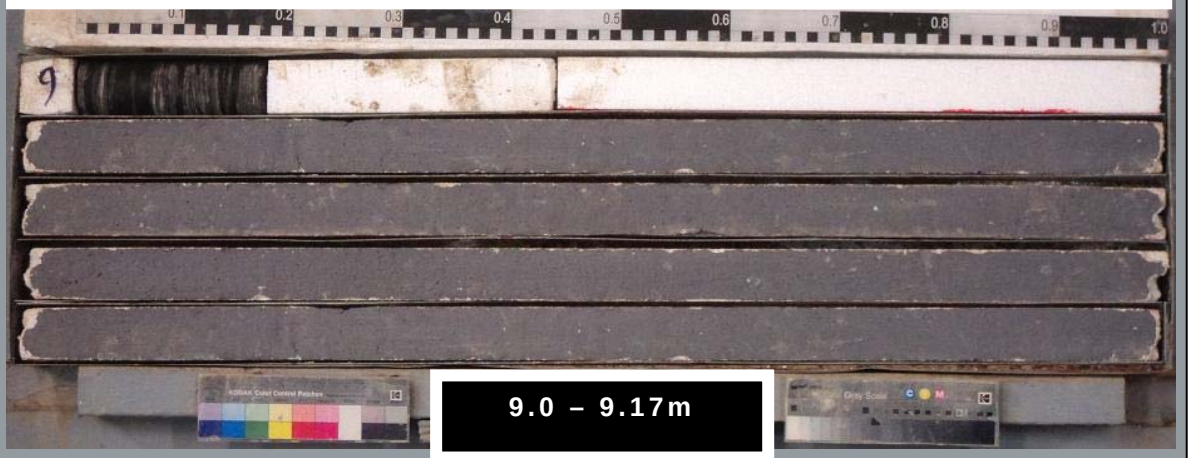


4.1 – 9.0m

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 2 PROJECT 73946 JUL 2014



9.0 – 9.17m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 17.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 73946
DATE: 11/7/2014
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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
17	0.03	ASPHALT							A/E			
	0.2	FILLING - grey-brown, slightly gravelly, sandy silt filling							A/E			
	0.4	FILLING - orange-brown, fine to medium sand filling (ripped sandstone) with some fine to medium gravel with a trace of concrete, humid							A			
16	1	FILLING - brown, silty clay filling with some ripped shale and with a trace of fine sand, charcoal and fine ironstone gravel, humid							A/E S			2,9,10 N = 19
15	2	FILLING - brown-grey, silty clay filling with a trace of fine gravel, charcoal, rootlets and fine sand, moist							E/S			2,2,4 N = 6
14	3	SILTY CLAY - stiff to very stiff, brown, silty clay with a trace of ironstone gravel, moist 3.8m: hard, humid						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
13	4	LAMINITE - very low then very low to low strength, highly weathered, grey and grey-brown, laminite with a trace of carbonaceous material							S C	100	0	25/90mm refusal
12	5	LAMINITE - medium strength, highly to moderately then slightly weathered, fractured and slightly fractured, grey-brown, laminite with approximately 20% fine sandstone laminations and some clay bands						4.32-4.62m: B (x6) 0°, cly, 2-5mm 4.75m: B0°, cly co, 2mm 4.9m: B0°, cly, 15mm 4.93m: B0°, cly, 30mm 4.99m: B0°, cly, 5mm 5.12m: J40°, pl, ro, fe 5.17m: B0°, cly co 5.5m: B0°, cly, 5mm 5.6m: J70°, pl, ro, cln 5.65-5.75m: B (x3) 0°, fe, cly, 2-5mm 6.1-6.95m: B (x3) 0°, fe, cly	C	100	62	PL(A) = 0.5 PL(A) = 0.6
11	6	LAMINITE - high and medium to high strength, fresh, slightly fractured then unbroken, light grey to grey laminite with approximately 20% fine sandstone laminations										PL(A) = 1.4
10	7											PL(A) = 1
9	8							7.62m: J85°, pl, ro, cln 7.8m: J35°, pl, ro, cln 7.87m: J50°, pl, ro, cln	C	100	97	PL(A) = 1.2
8	9											PL(A) = 1.5
	9.17	Bore discontinued at 9.17m										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.1m; NMLC-Coring to 9.17m

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)

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Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

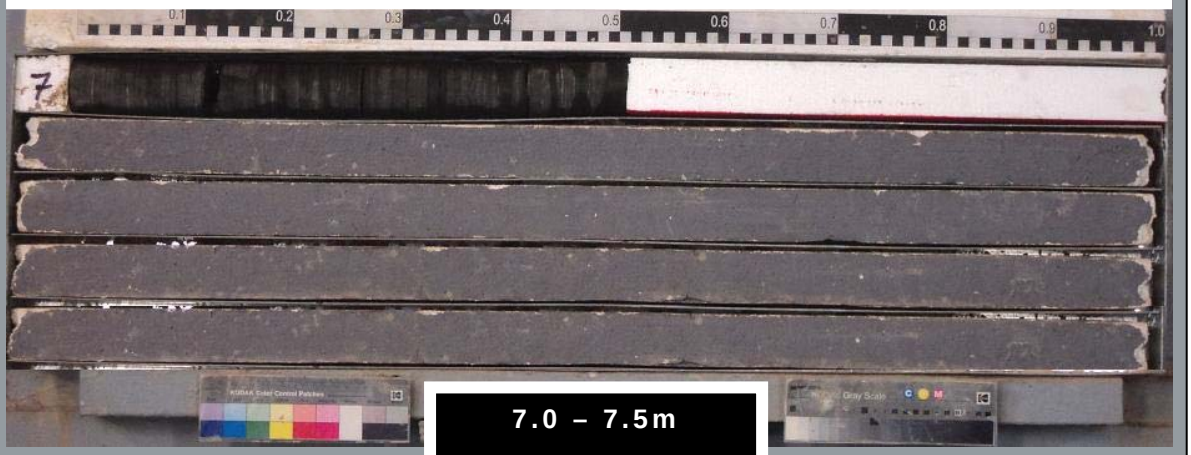
BORE 3 PROJECT 73946 JUL 2014

2.1 – 7.0m

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 3 PROJECT 73946 JUL 2014



7.0 – 7.5m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 73946
DATE: 8/7/2014
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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
14	0.1	ASPHALT							A/E			
	0.2	FILLING - light grey, gravelly, sandy silt filling										
		FILLING - orange-brown, fine to medium sand filling with some silt and gravel (ripped sandstone), humid							A.E			
13	1								A/E			
	1.4							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	E/S			6,17,17 N = 34
	1.6	FILLING - brown, silty clay filling with some ripped shale and fine gravel and a trace of building rubble										
	2	LAMINITE - extremely low and very low strength, extremely and highly weathered, fragmented to highly fractured, grey-brown laminite with some low and medium strength bands						2.1-2.37m: fg, fe, cly	C	76	0	
12	2.54							2.43m: CORE LOSS: 110mm				
								2.59-3.0m: fg, fe, cly				PL(A) = 0.5
	3							3.2m: B0°, fe	C	77	10	
11								3.8-3.9m: fg, fe				
	4							4.15m: CORE LOSS: 460mm				
10	4.61	LAMINITE - medium and medium to high strength, moderately weathered then fresh stained and fresh, slightly fractured, grey-brown then grey, laminite with approximately 25% fine sandstone laminations						4.7m: J30°, pl, ro, cln				PL(A) = 0.6
	5							4.85-4.96m: J, sv, (80°-85°), pl, ro, cln, partially he				
								5.18 & 5.38m: B0°, cly, 5-10mm				PL(A) = 0.9
9								5.45-5.8m: B (x4) 0°, cly co, 2-5mm				
	6							6.16m: B0°, fe	C	97	84	
8								6.36-6.6m: J80°, un, ro, fe				PL(A) = 1
	7							6.81m: B0°, fe				
7												PL(A) = 0.8
	7.5	Bore discontinued at 7.5m										
6	8											
5	9											

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.1m

TYPE OF BORING: Solid flight auger to 2.1m; NMLC-Coring to 7.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Gravel filling 7.0-7.5m then standpipe installed to 7.0m (screen 4.0-7.0m; gravel 3.5-7.0m; bentonite 3.0-3.5m; backfill to GL; 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

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 4 PROJECT 73946 JUL 2014

1.45 – 6.0m

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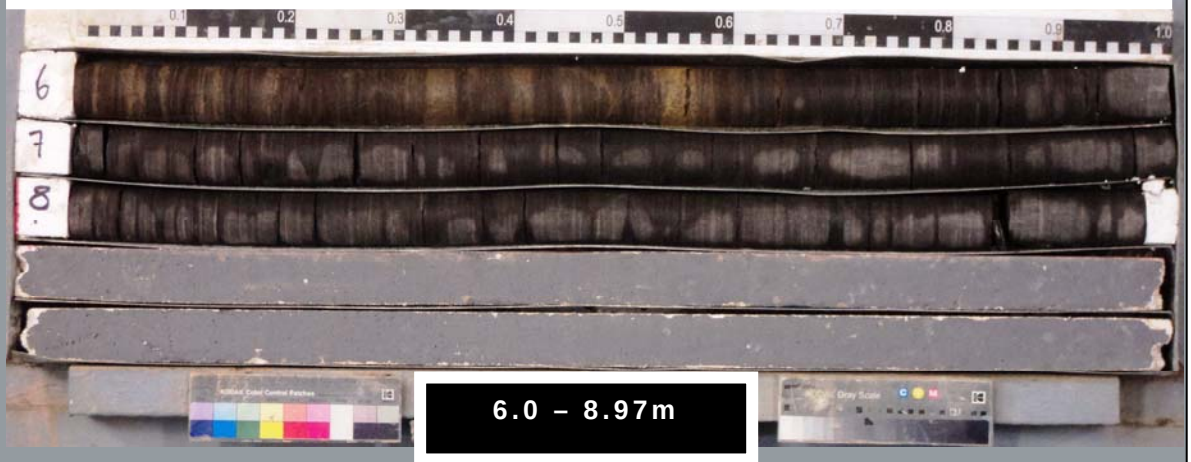
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 4 PROJECT 73946 JUL 2014



6.0 – 8.97m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 73946
DATE: 11/7/2014
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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
18	0.3	FILLING - brown, silty clay filling with some fine sand and fine to medium gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	0.7	FILLING - grey-brown, silty clay filling with a trace of fine gravel, timber, charcoal and brick, moist										
17	1	SILTY CLAY - very stiff, light brown mottled grey, silty clay with a trace of ironstone gravel, moist										
	1.3											
	1.45	1.0m: becoming shaly clay with some ironstone bands and a trace of rootlets						1.45-1.65m: fg	C	100	34	PL(A) = 1.2
16	1.95	LAMINITE - very low strength, highly weathered, grey shale with some fine bands of low strength, grey-brown laminite						1.75m: CORE LOSS: 200mm 1.95-2.35m: fg, fe				PL(A) = 1.1
	2.3	LAMINITE - high strength, highly to moderately weathered, fragmented, grey-brown laminite with approximately 20% fine sandstone laminations						2.42m: B0°, cly, 10mm 2.46-2.52m: J70°, un, ro, fe, cly 2.56m: B0°, cly, 5mm 2.7m: B0°, cly, 20mm 2.81-2.9m: B0°, fe, cly, 5mm	C	87	62	PL(A) = 0.6
15	3	LAMINITE - medium strength, highly to moderately then moderately weathered, fractured and slightly fractured, grey-brown, laminite with approximately 25% fine sandstone laminations. Some extremely low strength bands						3.13m: J50°, un, ro, fe 3.52-4.17m: B (x4) 0°, cly, 2-5mm				
14	4							4.35m: B0°, cly co, 1mm	C	100	94	PL(A) = 0.7
13	5											PL(A) = 0.6
12	6							5.5m: J35°, un, ro, fe 5.55m: J50° & 85°, st, ro, fe 5.77-6.2m: B's 0°, cly				
	6.6	LAMINITE - high and medium to high strength, fresh, slightly fractured and unbroken, grey laminite with approximately 20% fine sandstone laminations						6.32m: B0°, cly, 20mm 6.46m: J45°, pl, ro, fe 6.56m: B0°, fe, cly, 25mm 6.64m: B0°, fe 6.82-7.68m: B (x3) 0°, cly co, 1-2mm				PL(A) = 0.6 PL(A) = 1.5
11	7								C	100	100	PL(A) = 1
10	8											PL(A) = 1.3
9	8.97	Bore discontinued at 8.97m										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 1.0m
TYPE OF BORING: Solid flight auger to 1.0m; Rotary to 1.45m; NMLC-Coring to 8.97m
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)

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SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 5 PROJECT 73946 JUL 2014

2.8 – 7.0m

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 5 PROJECT 73946 JUL 2014

7.0 – 8.3m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 73946
DATE: 10/7/2014
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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
13	0.02	ASPHALT							A/E			
	0.3	FILLING - grey, gravelly clay filling with a trace of brick and concrete							A/E			
12	1	FILLING - brown and grey, silty clay filling with some fine gravel (mostly ironstone and shale) and a trace of charcoal 0.6m: trace of brick 1.0m: trace of fine slag gravel and ripped sandstone 1.2m: some thin bands of ripped shale							A/E E/S			2,9,25/90mm refusal
	1.8	FILLING - brown, silty clay filling with a trace of fine ironstone gravel, charcoal and ripped shale						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A			
11	2.2	LAMINITE - extremely low strength, extremely weathered, grey shale with some thin bands of very low to low strength, grey-brown laminite							S			19,25/80mm refusal
	3							2.8m: CORE LOSS: 450mm				
10	3.25	LAMINITE - low to medium then medium strength, highly to moderately then moderately weathered, fragmented to fractured, grey-brown, laminite with approximately 20% fine sandstone laminations and some very low strength bands						3.25-3.65m: fg, fe 3.65-3.7m: Ds	C	80	14	PL(A) = 0.3
	4							4.08m: J50°, un, ro, cly 4.12-4.26m: fg, fe 4.3m: J40°, pl, ro, fe, cly				PL(A) = 0.3
9	4.63							4.38-4.45m: J85°, un, ro, fe 4.53m: CORE LOSS: 100mm 4.63-4.84m: fg, fe 4.84-5.0m: B (x9) 0°, fe				PL(A) = 0.8
	5	LAMINITE - high strength, fresh, slightly fractured, light grey to grey laminite with approximately 25% fine sandstone laminations						5.37-5.71m: B (x3) 0°, fe				PL(A) = 1.6
8	6							6.07m: J30°, un, ro, cln	C	96	73	PL(A) = 1.7
	7							6.7-6.83m: J55°- 79°, cu, sm, fe 6.85-7.25m: J85°, pl, ro, cln				PL(A) = 0.9
6	7.0	SHALE - medium strength, fresh, slightly fractured, grey shale						7.45-7.6m: J90°, pl, ro, cln 7.65m: J85°, pl, ro, cln	C	100	100	
	8							8.05 & 8.17m: J65°, pl, sm, cln				PL(A) = 0.6
5	8.3	Bore discontinued at 8.3m										
	9											
4												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.8m; NMLC-Coring to 8.3m

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)

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SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

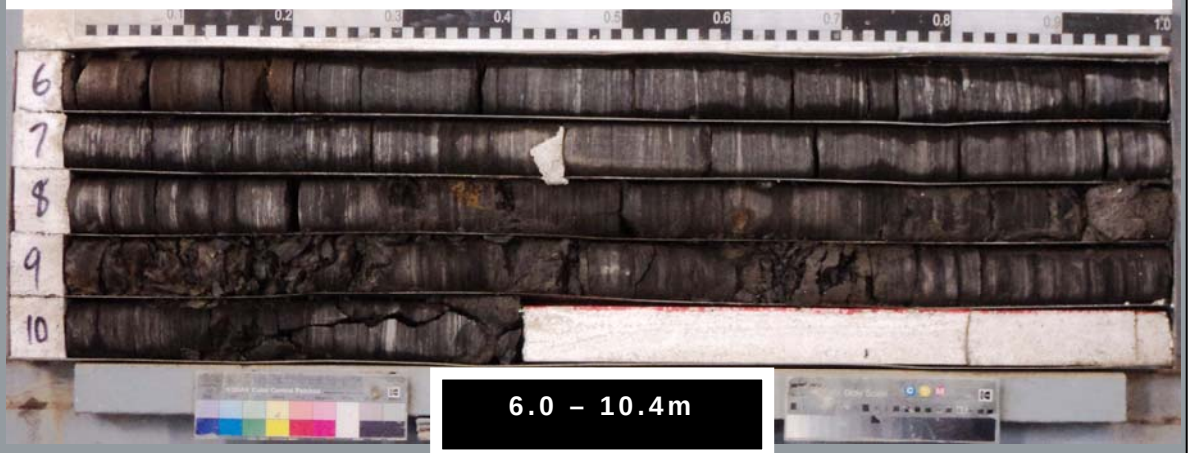
BORE 6 PROJECT 73946 JUL 2014

2.0 – 6.0m

DOUGLAS PARTNERS PTY LTD

SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 6 PROJECT 73946 JUL 2014



6.0 – 10.4m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 73946
DATE: 9/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
14	0.0	FILLING - brown, silty clay filling with some rootlets and a trace of fine to medium gravel, humid							A/E			
	0.3	SILTY CLAY (possible filling) - red-brown, silty clay with some fine ironstone gravel							A/E			
13	0.8	LAMINITE - very low strength, highly weathered, grey and red-brown laminite with a trace of rootlets and ironstone gravel						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A/E S			5,13,25/110mm refusal
12	2.0	LAMINITE - extremely low to very low strength, extremely to highly weathered, fragmented to fractured, grey-brown laminite with some low to medium and medium strength bands						2m: CORE LOSS: 370mm 2.5-2.64m: fg 2.77-2.79m: cly 2.85-2.91m: B's 0°, cly 3.05m: B0°, cly, 5mm	C	78	0	PL(A) = 0.6 PL(A) = 0.4
11	2.37											
10	3.82	LAMINITE - low to medium and medium strength, moderately weathered, fragmented to fractured and slightly fractured, grey-brown laminite with approximately 20% fine sandstone laminations						3.77-3.84m: cly 3.88m: B0°, cly 3.95m: J70°, pl, ro, fe 4.0-4.06m: fg 4.12m: J60°, un, ro, cly 4.18-4.3m: J80°, un, ro, fe 4.43m: CORE LOSS: 220mm 4.65-4.73m: fg 4.77-4.88m: cly 4.9-5.05m: fg 5.05m: J70°, un, ro, cln 5.2m: J75°, un, ro, cln 5.3m: J75°, pl, ro, fe 5.45m: J45°, pl, ro, cln 5.65m: J90°, pl, sm, cln 5.9m: J55°, pl, sm, cln 6.17m: B0°, cly, 10mm	C	89	40	PL(A) = 0.3 PL(A) = 0.4
9	4.65											
8	6.2	LAMINITE - high strength, slightly weathered then fresh, slightly fractured then unbroken, light grey to grey laminite with approximately 25% fine sandstone laminations						6.67 & 6.93m: B0°, fe	C	100	100	PL(A) = 1.2 PL(A) = 1.5
7	8.3	LAMINITE - low to medium and medium strength, fresh, fragmented to fractured then slightly fractured, grey to grey laminite with approximately 20% fine sandstone laminations. Some very low strength bands						8.3m: J60°, un, ro, cln 8.35-8.5m: J70°, un, ro, fe 8.5m: J45°- 70°, pl, sm, cln 8.74-8.9m: B's -°, cly 8.9m: J85°- 90°, pl, sm, cly 9.04-9.22m: fg, cly 9.26m: J55°, pl, sm, cly 9.4-9.46m: Cz, cly 9.5m: J45°, pl, sm, cln	C	100	68	PL(A) = 1.2 PL(A) = 0.3 PL(A) = 0.9
6												
5												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m; NMLC-Coring to 10.4m

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)

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BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 73946
DATE: 9/7/2014
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
								9.6m: J90°, pl, sm, cln 9.63-9.73m: Cz 10.12m: J65°- 70°, pl, sm & J85°, un, ro, cln 10.35m: J70°, pl, sm, cln	C	100	68	PL(A) = 0.8
	10.4	Bore discontinued at 10.4m										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.0m
TYPE OF BORING: Solid flight auger to 2.0m; NMLC-Coring to 10.4m
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)

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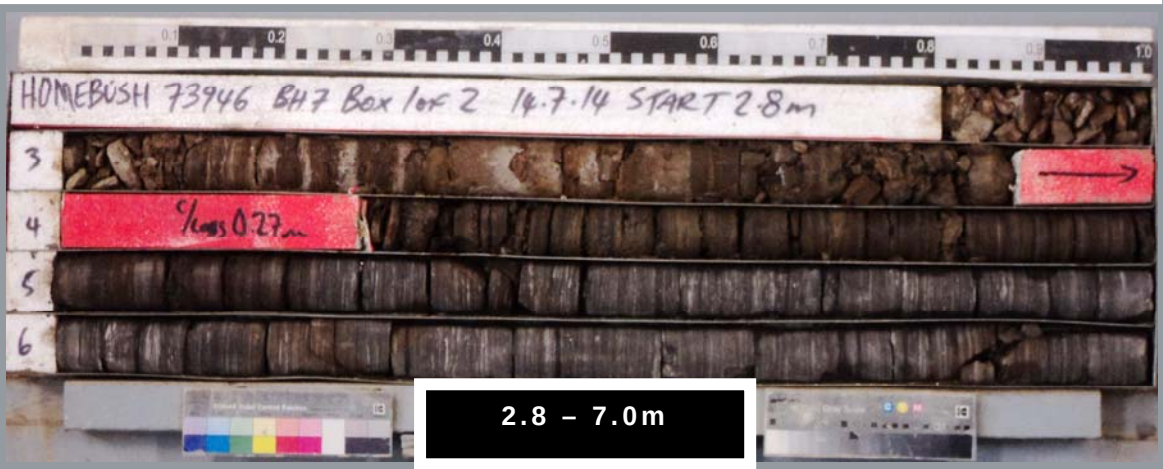
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 7 PROJECT 73946 JUL 2014



2.8 – 7.0m

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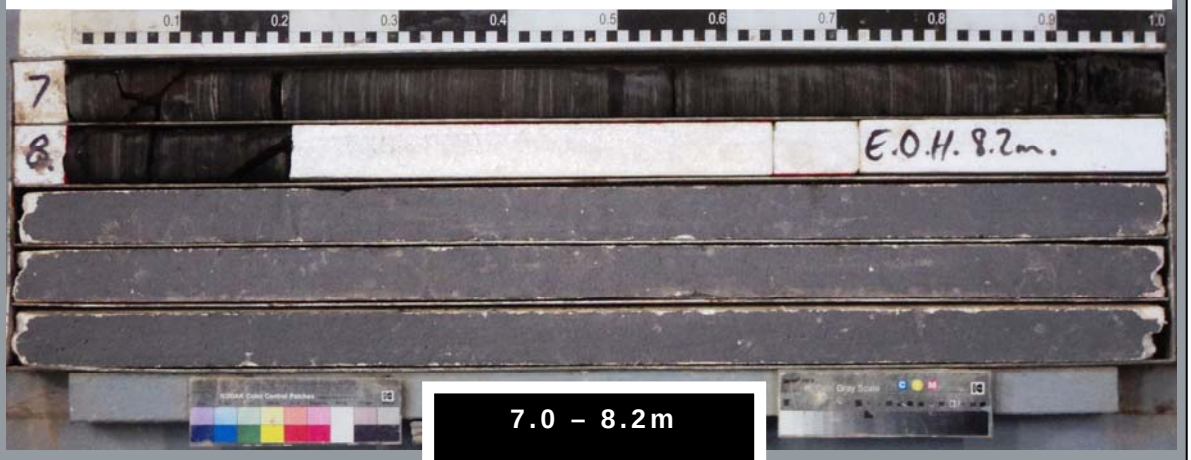
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 7 PROJECT 73946 JUL 2014



7.0 – 8.2m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 73946
DATE: 14/7/2014
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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
14	0.2	FILLING - brown, slightly gravelly, clayey silty sand filling with some rootlets, humid							A/E			
	0.7	SILTY CLAY (possible filling) - hard, brown, silty clay, humid							A/E			
13	1	SHALY CLAY - hard, red-brown and orange-brown mottled grey, shaly clay with some ironstone bands/gravel and a trace of rootlets							A/E S			6,10,17 N = 27
12	2.0	LAMINITE - extremely low to very low strength, extremely weathered, grey laminite with some ironstone bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			13,25/100mm refusal
	2.8	LAMINITE - low and low to medium strength, highly to moderately weathered, fragmented to fractured, grey-brown laminite with some extremely low strength clay bands						2.8-3.12m: fg 3.12-3.32m: B'x 0°, cly, 2-10mm 3.46m: B0°, fe, cly, 10mm 3.5m: J30°, un, ro, fe 3.6m: B0°, fe & J60°, pl, sm, fe 3.66m: B0°, cly, 5mm 3.7-3.9m: fg, fe 3.9m: CORE LOSS: 370mm	C	75	0	PL(A) = 0.2
11	3											
10	4											
	4.27	LAMINITE - medium strength, highly to moderately then moderately weathered, fractured and slightly fractured, grey-brown laminite with approximately 20% fine sandstone laminations and some clay bands						4.27-4.81m: B (x13) 0°, cly co, 1-5mm 4.98-5.17m: B (x3) 0°, fe, cly, 5-10mm 5.35m: J65°, pl, ro, fe				PL(A) = 0.4
9	5											
	5.2	LAMINITE - high then medium strength, fresh stained then fresh, slightly fractured, light grey to grey laminite with approximately 25% fine sandstone laminations							C	100	68	PL(A) = 1.3
8	6							6.22m: J65°, pl, ro, fe 6.82m: J60°, un, ro, fe				PL(A) = 1
7	7							7.05m: J85° & 45°, st, ro, fe				PL(A) = 1.1
6	8							7.91-7.96m: fg, cly 8.13m: J45° - 60°, cu, ro, cln	C	100	90	PL(A) = 0.7
	8.2	Bore discontinued at 8.2m										
5	9											

RIG: Scout 1 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.8m; NMLC-Coring to 8.2m

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)

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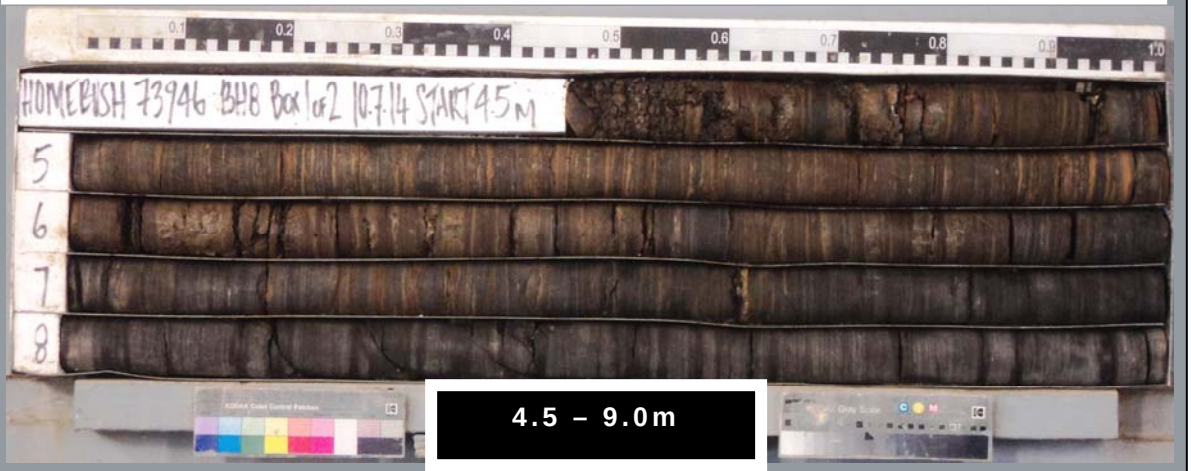
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 8 PROJECT 73946 JUL 2014



4.5 – 9.0m

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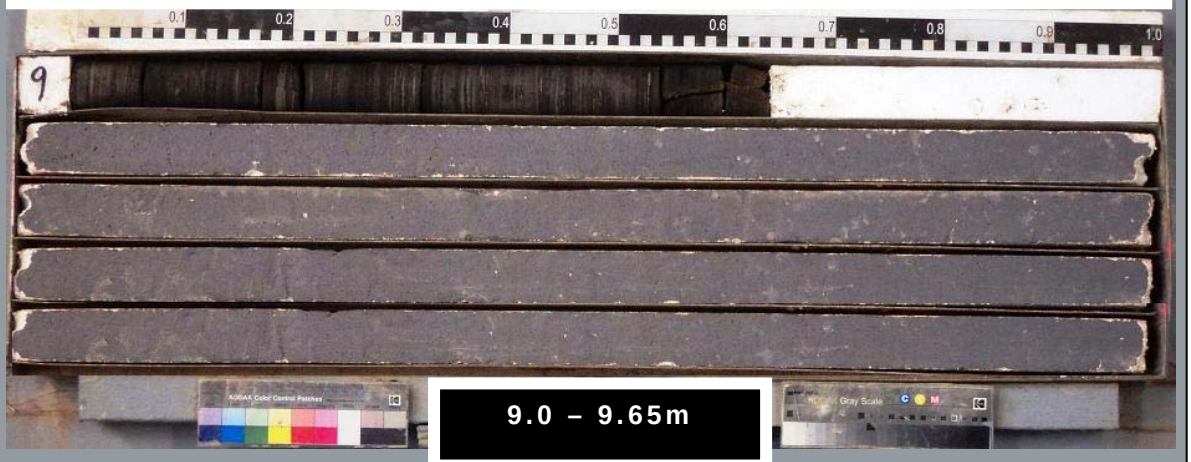
SITE 53 GEOTECHNICAL INVESTIGATION – SYDNEY OLYMPIC PARK

BORE 8 PROJECT 73946 JUL 2014



9.0 – 9.65m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Site 53 Geotechnical Investigation
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 73946
DATE: 17/7/2014
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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
13	0.03	ASPHALT							A/E			
	0.2	FILLING - grey, gravelly silty sand filling, humid							A/E			
		FILLING - brown, silty clay filling with some gravel, humid										
	0.8	FILLING - grey and brown, silty clay and ripped shale filling with some gravel and a trace of rootlets, charcoal and fine slag gravel, humid							A/E			
12	1								S			5,6,9 N = 15
11	2											
	2.7	FILLING - brown, slightly gravelly, silty clay filling with a trace of fine sand, humid							E/S A			3,9,9 N = 18
10	3								A			
	3.0	SILTY CLAY - very stiff to hard, brown mottled grey and red-brown, silty clay, humid										
	3.6	LAMINITE - very low strength, highly weathered, grey and brown laminite with a trace of organic material						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
9	4								S			14,18,25/100mm refusal
	4.45	LAMINITE - very low to low strength, highly weathered, fragmented to fractured, grey-brown laminite						4.45-4.6m: fs, fe				
	4.9	LAMINITE - medium and high strength, moderately then slightly weathered, fractured and slightly fractured, brown then grey-brown laminite with approximately 25% fine sandstone laminations						4.64m: B0°, fe, cly, 20mm 4.71m: B0°, fe, 2mm 4.76-4.93m: B0°, fe	C	100	70	PL(A) = 0.1
8	5							5.5-6.11m: B (x6) 0°, fe, cly, 5-20mm				PL(A) = 0.7
	6							6.15-6.2m: fg, fe 6.27-6.61m: B (x6) 0°, fe, cly, 2-10mm				PL(A) = 1.4
7	7							6.65m: J40°, fe 6.79m: B0°, fe, cly, 5mm 6.81m: J50°, pl, sm 6.86-7.18m: B (x4) 0°, fe 7.25-7.51m: B (x9) 0°, cly, fe, 0-2mm				PL(A) = 0.7
	7.6	LAMINITE - high strength, fresh, slightly fractured, light grey to grey laminite with approximately 20% fine sandstone laminations						7.67m: J40°, fe, cly 7.73m: J50°, pl, ro	C	100	62	
6	8							8.2m: J40°, pl, sm 8.28m: J40°, pl, ro 8.38m: J65°, pl, sm				PL(A) = 1.1
5	9							8.96m: B0°, fe	C	100	100	PL(A) = 1.5
4	9.65	Bore discontinued at 9.65m						9.55-9.64m: J80°, pl, ro, fe				

RIG: Scout 1 **DRILLER:** SS **LOGGED:** IW/SI **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 4.45m; NMLC-Coring to 9.65m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 9.65m (screen 4.65-9.65m; gravel 3.0-9.65m: bentonite 2.5-3.0m; backfill to GL; 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)

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Appendix D

Results of Current Field Work

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.

Soil Descriptions

Douglas Partners

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:

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

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

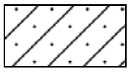
Soils


Topsoil

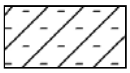

Peat


Clay

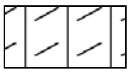

Silty clay

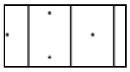

Sandy clay

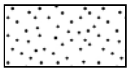

Gravelly clay

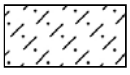

Shaly clay

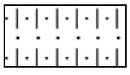

Silt


Clayey silt


Sandy silt

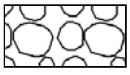

Sand

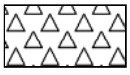

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

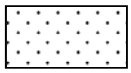

Talus

Sedimentary Rocks

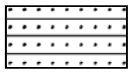

Boulder conglomerate

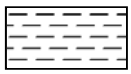

Conglomerate


Conglomeratic sandstone

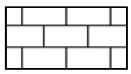

Sandstone


Siltstone


Laminite

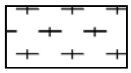

Mudstone, claystone, shale

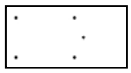

Coal


Limestone

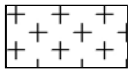
Metamorphic Rocks

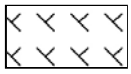

Slate, phyllite, schist

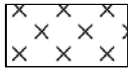

Gneiss

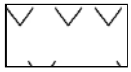

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

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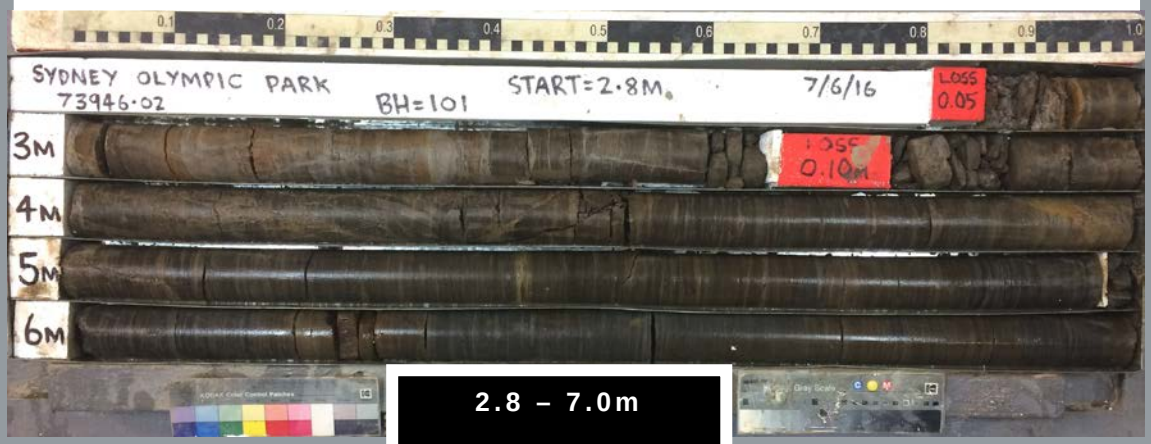
BORE 101 PROJECT 73946.02 JUN 2016



2.8 – 7.0m

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BORE 101 PROJECT 73946.02 JUN 2016

7.0 – 12.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 20.1 AHD
EASTING: 321608
NORTHING: 6252887
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 73946.02
DATE: 7/6/2016
SHEET 1 OF 3

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
20	0.07	ASPHALT										
	0.2	FILLING - brown, clayey sandy fine to medium gravel filling (igneous and sandstone gravel)							A			
		FILLING - brown, slightly gravelly, clayey fine to medium grained sand filling (fine to medium igneous and sandstone gravel), moist							A			
19	0.9	LAMINITE - extremely low strength, light grey and brown laminite							S			30 refusal
	1	1.0m: extremely low to very low strength with some low strength bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
18	2											
	2.8								S			30/30mm refusal
	2.85	LAMINITE - extremely low to very low strength, extremely to highly weathered, fragmented, grey and brown laminite						2.8m: CORE LOSS: 50mm 2.85m: fg, 50mm 2.91m: J85°, pl, ro, fe 2.93m: B0°, pl, ro,cly vn, fe	C	94	62	PL(A) = 0.8
17	2.93											
	3	LAMINITE - low to medium strength, highly to moderately weathered, fractured, grey and brown laminite						3m: cly, 10mm 3.12-3.19m: J (x2) 75°-80°, pl-un, ti 3.48m: J (x2) 80°, pl, ro 3.59m: J90°, pl, ro, cln 3.65m: CORE LOSS: 100mm				
	3.75	4.0m: 520mm fragmented zone							C	96	59	PL(A) = 0.2
16	4											PL(A) = 0.4
	4.52	LAMINITE - medium strength, moderately to slightly weathered, fractured to slightly fractured, grey and brown laminite						3.75m: J (x2) 90°, pl, ro, cln-cbs 3.93m: B5°, un, fg, 3mm 4.0-5.42m: fg, 520mm 4.4m: J45°, pl, cly, 5mm 4.88m: J55°, un, ti 5m: J75°, un, ti 5.42-5.65m: B (x3) 0°, pl, ro, cln vn, ti 5.51m: J0°- 20°, un, ro, cly vn, ti 5.72m: B0°, pl, ro, cly vn 5.77m: J45°, pl, ro, fe 5.96m: J (x2) 45°, un, ro, cln 6.21m: J90°, pl, ro, fe 6.21-6.29m: B (x5) 0°, pl, ro, fe				PL(A) = 0.7
15	5											PL(A) = 1.2
14	6											
13	7							7.53m: B0°, pl, sm, fe 7.94m: B0°, pl, ro, fe	C	100	72	PL(A) = 0.9 PL(A) = 0.9
12	8							8.19-8.2m: B (x2) 0°, pl, sm, fe 8.2m: J75°, un, ti-ro, fe 8.29m: B0°, pl, sm, cly vn 8.36m: J60°- 70-°, ti, cly, 2mm				PL(A) = 0.5
	8.66	LAMINITE - medium strength, fresh, slightly fractured, grey laminite										
11	9							8.42m: J (x2) 80°- 90°, ti 8.45-8.74m: J (x20), 45°, pl-un, ti-fe 8.64m: fg, 10mm 8.8-8.87m: B (x3) 5°-25°, pl-un, ro-sm, fe	C	100	100	PL(A) = 1.2
	9.6	LAMINITE - high strength, fresh, unbroken, grey laminite										

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.8m; NMLC-Coring to 22.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 12.9m on 21/06/16

REMARKS: Groundwater monitoring well installed to 22.0m (screen 16.0-22.0m; gravel 15.0-22.0m; bentonite 14.0-15.0m; gatic cover at surface)

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

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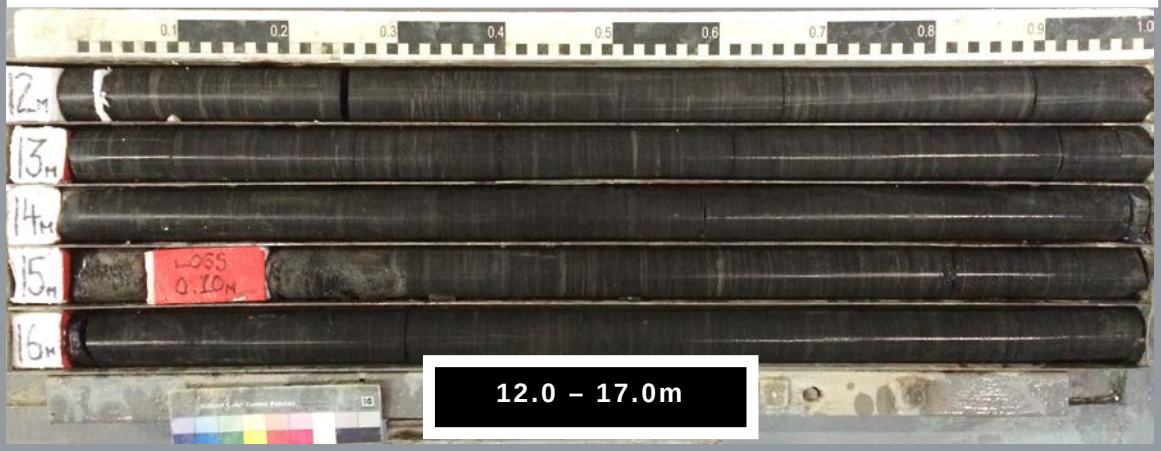
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 101 PROJECT 73946.02 JUN 2016



12.0 – 17.0m

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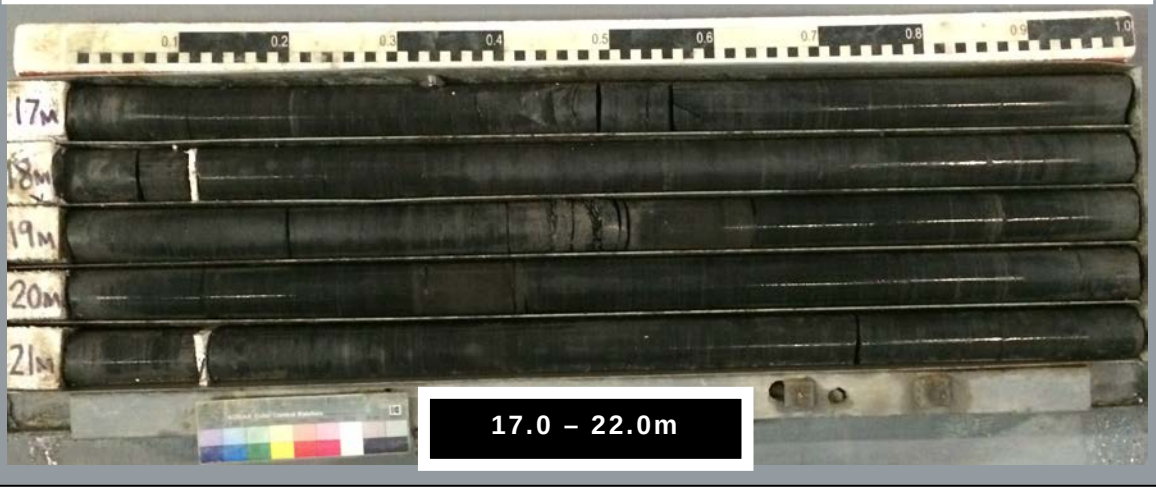
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 101 PROJECT 73946.02 JUN 2016



17.0 – 22.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 20.1 AHD
EASTING: 321608
NORTHING: 6252887
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 73946.02
DATE: 7/6/2016
SHEET 2 OF 3

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		LAMINITE - high strength, fresh, unbroken, grey laminite *(continued)*										
												PL(A) = 1.1
9	11								C	100	100	
												PL(A) = 1.9
8	12							>>				
												PL(A) = 0.7
7	13					21-06-16						
												PL(A) = 2.3
6	14								C	100	97	
												PL(A) = 1.5
5	15							14.98m: J45°, pl, ro, cln 14.99m: J90°, pl, ro, cln 15.08m: CORE LOSS: 100mm 15.19m: J (x2) 45°, pl, ti 15.22m: J (x2) 75°- 80°, pl, ti				
	15.18	- slightly fractured and unbroken from 15.2m										PL(A) = 1.6
4	16							16.16m: J90°, pl, ro, cln				PL(A) = 2.4
									C	97	95	
3	17							17.4-17.44m: J (x2) 45°-0 55°, pl, ti 17.56m: J15°, pl, sm, cln				
2	18											PL(A) = 1.1 PL(A) = 1.4
1	19							19.35m: B0°, pl, cly, 1mm 19.45m: B0°, fg, cly, 20mm 19.49m: B0°, fg, 10mm	C	100	99	PL(A) = 1.2

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.8m; NMLC-Coring to 22.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 12.9m on 21/06/16

REMARKS: Groundwater monitoring well installed to 22.0m (screen 16.0-22.0m; gravel 15.0-22.0m; bentonite 14.0-15.0m; gatic cover at surface)

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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BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 20.1 AHD
EASTING: 321608
NORTHING: 6252887
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 73946.02
DATE: 7/6/2016
SHEET 3 OF 3

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
0		LAMINITE - medium then high strength, fresh, unbroken, grey laminite *(continued)*						20.3m: J85°- 90°, pl, ro, cln	C	100	99	PL(A) = 1
-1	21											
								21.49m: J85°- 90°, pl, ro, cln	C	100	100	PL(A) = 1.3
-2	22 22.0	Bore discontinued at 22.0m										
-3	23											
-4	24											
-5	25											
-6	26											
-7	27											
-8	28											
-9	29											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.8m; NMLC-Coring to 22.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 12.9m on 21/06/16

REMARKS: Groundwater monitoring well installed to 22.0m (screen 16.0-22.0m; gravel 15.0-22.0m; bentonite 14.0-15.0m; gatic cover at surface)

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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PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

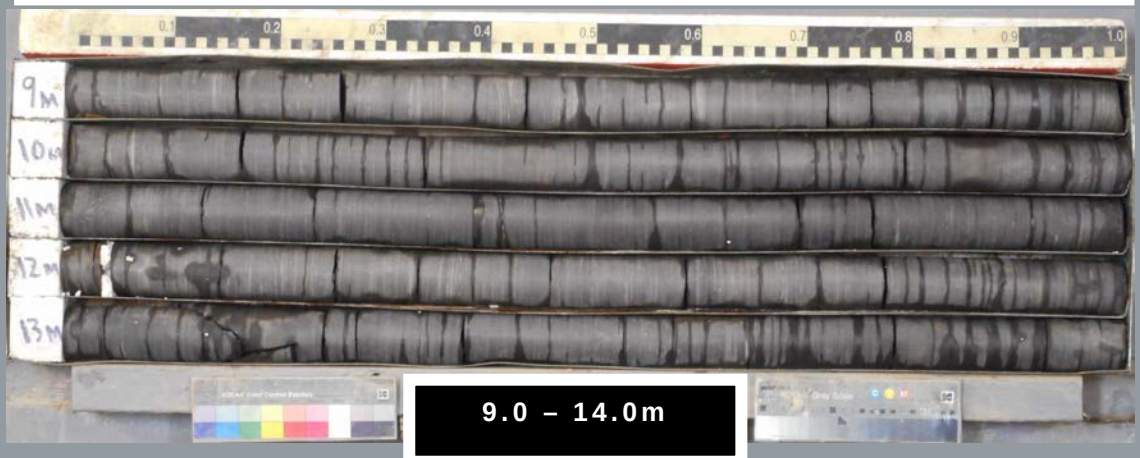
BORE 102 PROJECT 73946.02 JUN 2016

4.5 – 9.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 102 PROJECT 73946.02 JUN 2016



9.0 – 14.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 17.0 AHD
EASTING: 321641
NORTHING: 6252857
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 73946.02
DATE: 6/6/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
17	0.04	ASPHALT							A			
	0.4	FILLING - brown, slightly clayey, sandy, fine to medium gravel filling (igneous and concrete gravel), moist							A			
	0.7	FILLING - orange-brown, gravelly clayey medium grained sand filling (fine to coarse sandstone gravel) with a trace of brick and igneous gravel, moist							A			
16	1								S			6,7,11 N = 18
		FILLING - brown, silty clay filling with some fine to coarse gravel (ironstone, igneous, brick), and a trace of charcoal and fine to medium grained sand, moist										
15	2	- shale gravel and bands from 1.0m				▼						
									S			2,4,7 N = 11
14	3											
	3.2											
13	4								S			20 refusal
	4.6	LAMINITE - low to medium strength, moderately weathered, slightly fractured to fractured, brown and grey laminite with approximately 20% fine sandstone laminations						4.5m: CORE LOSS: 100mm 4.6m: J90°, pl, ro, fe 4.65m: cly, 20mm 4.76m: B0°, pl, ro, cln 5.23m: J85°, pl, ro, cln 5.35m: B0°, pl, cly, 10mm	C	94	90	PL(A) = 0.3 PL(A) = 1.1
12	5											
	5.45	SHALE - high strength, slightly weathered then fresh, slightly fractured then unbroken, grey shale with some fine sandstone laminations										
11	6											PL(A) = 1.4
10	7								C	100	100	PL(A) = 2.2
9	8											PL(A) = 2.2
	8.0	LAMINITE - high strength, fresh, unbroken, grey to light grey, laminite with approximately 20% fine sandstone laminations										
8	9							>>	C	100	100	PL(A) = 2.1

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 4.0m; HQ to 4.5m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 4.5m; NMLC-Coring to 19.0m

WATER OBSERVATIONS: Free groundwater observed at 2.3m 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)

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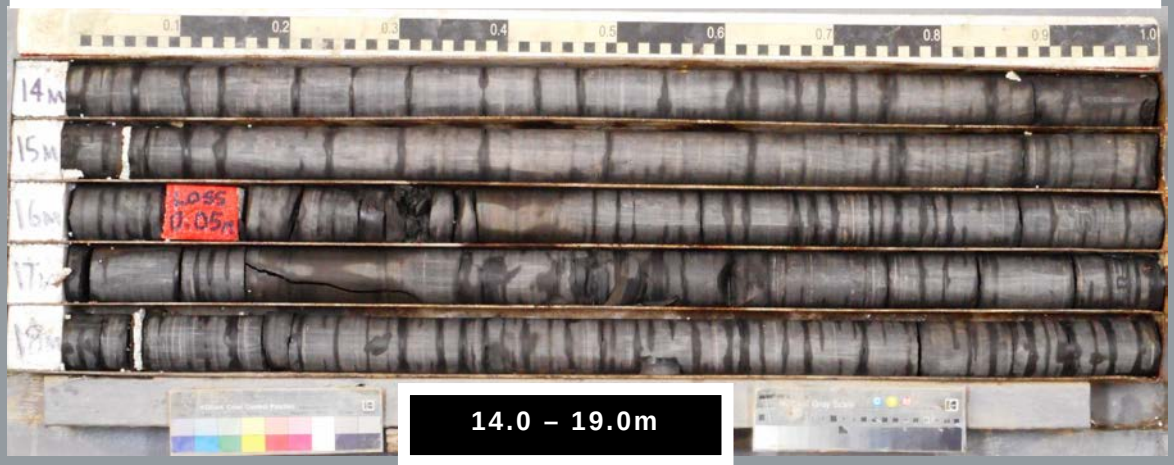
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 102 PROJECT 73946.02 JUN 2016



14.0 – 19.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 17.0 AHD
EASTING: 321641
NORTHING: 6252857
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 73946.02
DATE: 6/6/2016
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)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
6	11	LAMINITE - high strength, fresh, unbroken, grey to light grey, laminite with approximately 20% fine sandstone laminations *(continued)*							C	100	100	PL(A) = 2.4 PL(A) = 1.3
5	12											PL(A) = 1.7
4	13 13.0	SHALE - medium strength, fresh,slightly fractured and unbroken, grey shale with some fine sandstone laminations						13.08m: J60°, un, ro, cln 13.15m: J70°, pl, ro, cln 13.2m: J60°, pl, ro, cln	C	100	96	PL(A) = 0.7
3	14											PL(A) = 0.9
2	15											PL(A) = 0.9
1	16							16.27m: J80°, pl, ro, cln 16.3m: fg, 20mm 16.35m: J15°, pl, ro, cln	C	100	88	PL(A) = 0.6
0	17							17.16m: J70°- 90°, un, ti 17.35-17.62m: J (x14) 45°- 90°, un-pl, ro-cln				PL(A) = 0.6
-1	18								C	100	100	PL(A) = 1
-2	19 19.0	Bore discontinued at 19.0m										

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 4.0m; HQ to 4.5m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 4.5m; NMLC-Coring to 19.0m

WATER OBSERVATIONS: Free groundwater observed at 2.3m 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)

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PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

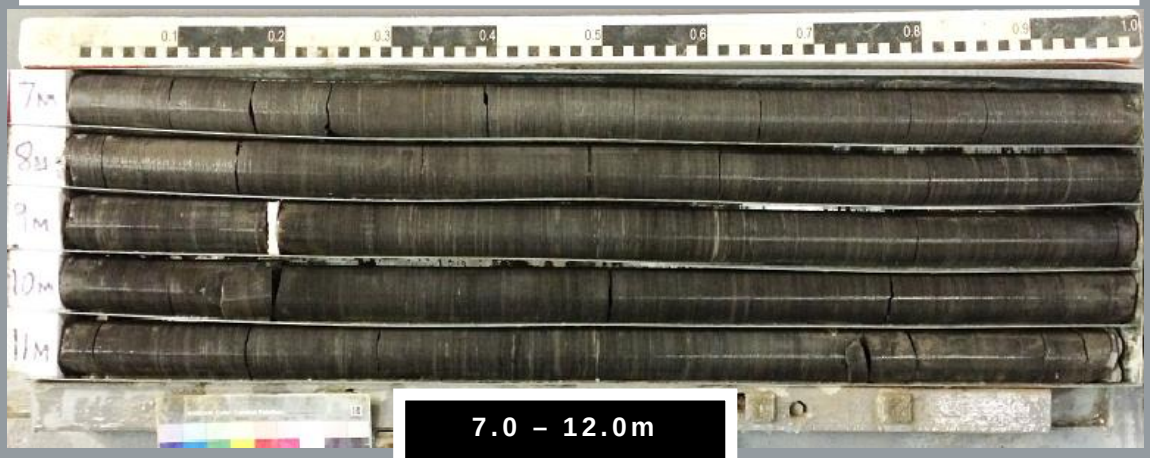
BORE 103 PROJECT 73946.02 JUN 2016

3.0 – 7.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 103 PROJECT 73946.02 JUN 2016



7.0 – 12.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.3 AHD
EASTING: 321663
NORTHING: 6252818
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 73946.02
DATE: 5/6/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
13	0.03	ASPHALT										
	0.2	FILLING - grey gravelly sandy silt filling							A			
	0.6	FILLING - brown sandy clay filling with some fine to medium sandstone gravel							A			
	1	0.5m: less gravelly										
12	1.2	SILTY CLAY - very stiff, grey mottled orange-brown, silty clay with a trace of fine to medium ironstone gravel, moist							A			
		LAMINITE - extremely low to very low strength, grey-brown laminite							S			
11	2											
	3								S			
	3.0	LAMINITE - low to medium strength, highly weathered, fractured to slightly fractured, grey and brown laminite with some clay bands up to 20mm						3.14m: B0°, cly, 15mm 3.16m: J (x2) 25°, pl, ro, cln-fe 3.31m: J25°, pl, ro, cln 3.32m: J (x3) 85°- 90°, pl, ro, fe 3.33m: cly, 10mm 3.35m: J (x2) 85°, pl, ro, fe 3.39m: cly, 20mm 3.7m: B0°, cly, 10mm 3.71m: J85°, pl, ro,cln 4m: J20°, pl, ro, ti 4.21m: cly, 15mm 4.52m: J30°, un, ro, cly vn, fe 4.78m: cly, 15mm 4.8m: J60°, pl, ro, fe	C	100		PL(A) = 0.3 PL(A) = 0.4
10	4											
9	4.8	LAMINITE - high strength, moderately weathered, unbroken, grey and brown laminite										
	5											PL(A) = 2.2
	5.0	LAMINITE - high strength, slightly weathered to fresh, unbroken, grey laminite										
8	6											PL(A) = 1.4
	6.48	SHALE - medium and high strength, fresh, unbroken, grey shale with approximately 5-10% sandstone laminations										
7	7											PL(A) = 1.6
6									C	100		
	8											PL(A) = 0.9
5						21-06-16						
	9											
4									C	100		PL(A) = 2.1

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Diacore to 0.16m; Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 15.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 8.9m on 21/06/16

REMARKS: Groundwater monitoring well installed to 15.3m (screen 9.3-15.3m; gravel 8.8-15.3m; bentonite 7.8-8.8m; gatic cover at surface)

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

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 103 PROJECT 73946.02 JUN 2016

12.0 – 15.3m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.3 AHD
EASTING: 321663
NORTHING: 6252818
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 73946.02
DATE: 5/6/2016
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)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
3		SHALE - medium and high strength, fresh, unbroken, grey shale with approximately 5-10% sandstone laminations *(continued)*						10.12m: J70°, pl, ro, cln				
		- slightly fractured from 10.1m										PL(A) = 1.8
2	11								C	100		PL(A) = 1.6
		- slightly fractured from 11.7m						11.72m: J70°, pl, ro, cln				
1	12							11.96m: J50°, pl, ro, cln 12.1m: J80°- 9-°, pl, ro, cln				PL(A) = 1.1
								12.44-12.51m: J (x3) 35°- 45°, pl, ro, cln 12.74m: J60°, un, ro, cln				
0	13							13.19m: J15°, pl, ro, cln 13.25m: J40°, pl, sm, cln 13.39m: cly, 10mm 13.4m: J45°, pl, sm, cln 13.6m: J50°, pl, sm, cln 13.81m: B0°, pl, sm, cln	C	100		PL(A) = 0.8
-1	14							14.25m: J10°- 90°, un, ti				PL(A) = 1.2
	15							15.12m: J25°, pl, ro, cln				PL(A) = 1.2
-2	15.3	Bore discontinued at 15.3m										
	16											
-3												
	17											
-4												
	18											
-5												
	19											
-6												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Diacore to 0.16m; Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 15.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 8.9m on 21/06/16

REMARKS: Groundwater monitoring well installed to 15.3m (screen 9.3-15.3m; gravel 8.8-15.3m; bentonite 7.8-8.8m; gatic cover at surface)

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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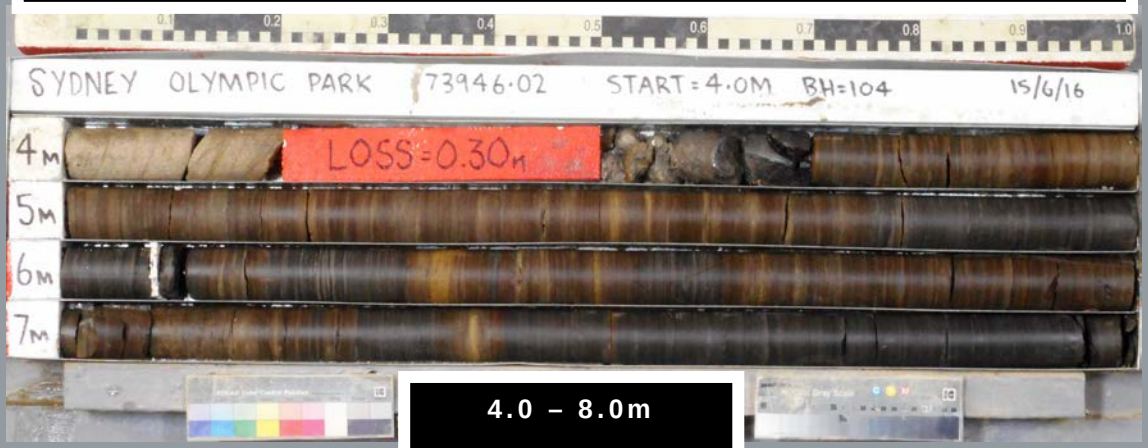
DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 104 PROJECT 73946.02 JUN 2016

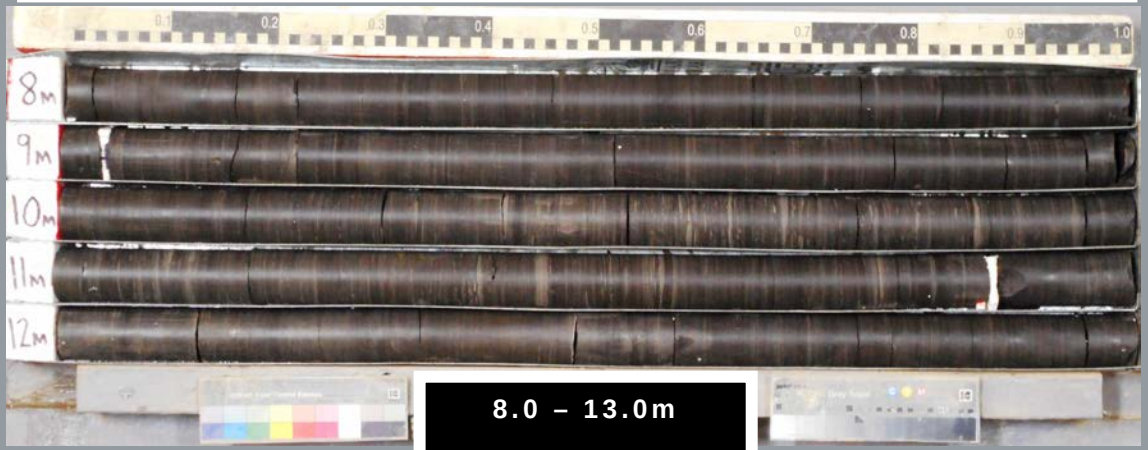


4.0 – 8.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 104 PROJECT 73946.02 JUN 2016



8.0 – 13.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.8 AHD
EASTING: 321647
NORTHING: 6252923
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 73946.02
DATE: 15/6/2016
SHEET 1 OF 3

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
18	0.1	FILLING (TOPSOIL) - brown sandy silty clay filling with rootlets, moist							A			
		FILLING - brown, slightly gravelly, sandy clay filling (fine to coarse shale, charcoal, slag, brick, sandstone, igneous gravel)							A			
1		0.5m: trace of sandstone cobbles							A			2,3,3 N = 6
		0.8m: grey and brown							S			
17												
2												
									S			23/50mm refusal
16												
3								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
15	4.0	FILLING - grey shale fragments and sandstone boulder filling										
	4.5							4.2m: CORE LOSS: 300mm				
14	4.7	LAMINITE - medium strength, moderately weathered, slightly fractured, grey-brown laminite with approximately 20% fine sandstone laminations						4.8m: J30°, pl, ro, fe	C	85	65	PL(A) = 0.5
5												
								5.5m: B0°, fe, cly				PL(A) = 0.5
13												
6												
								6.35m: B5°, fe, cly, 10mm				
12								6.45 & 6.85m: B0°, fe, cly				PL(A) = 0.8
7								6.85-7.1m: J, sv, 85°, un, ro, cln				
	7.3	LAMINITE - medium to high and high strength, fresh, slightly fractured then unbroken, grey laminite with approximately 20% fine sandstone laminations						7.4m: B0°, fe, cly, 5mm	C	100	100	PL(A) = 1.2
11												
8												PL(A) = 1.3
10												
9								9.21m: B5°, cly co, 2mm				
									C	100	100	PL(A) = 1
9												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Hand auger to 1.0m; Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 21.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

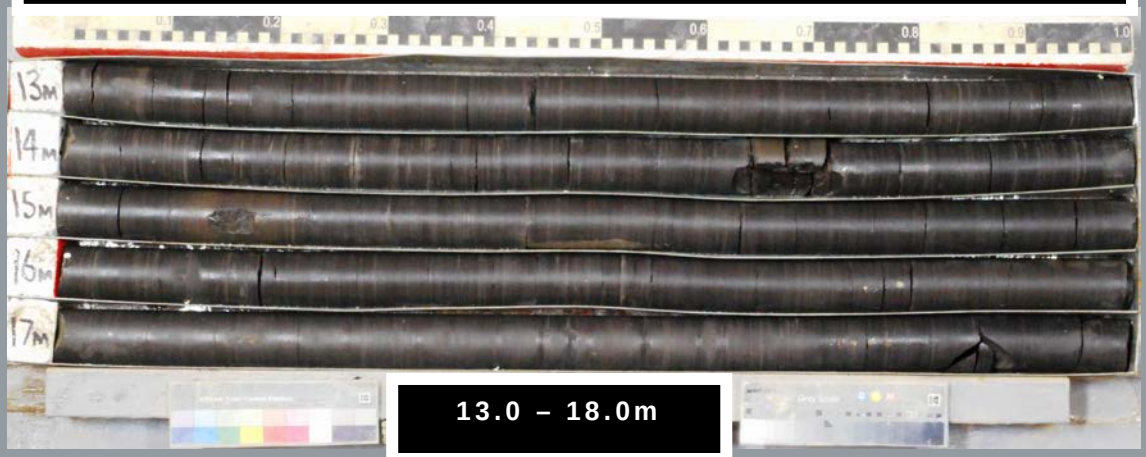
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample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

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 104 PROJECT 73946.02 JUN 2016



13.0 – 18.0m

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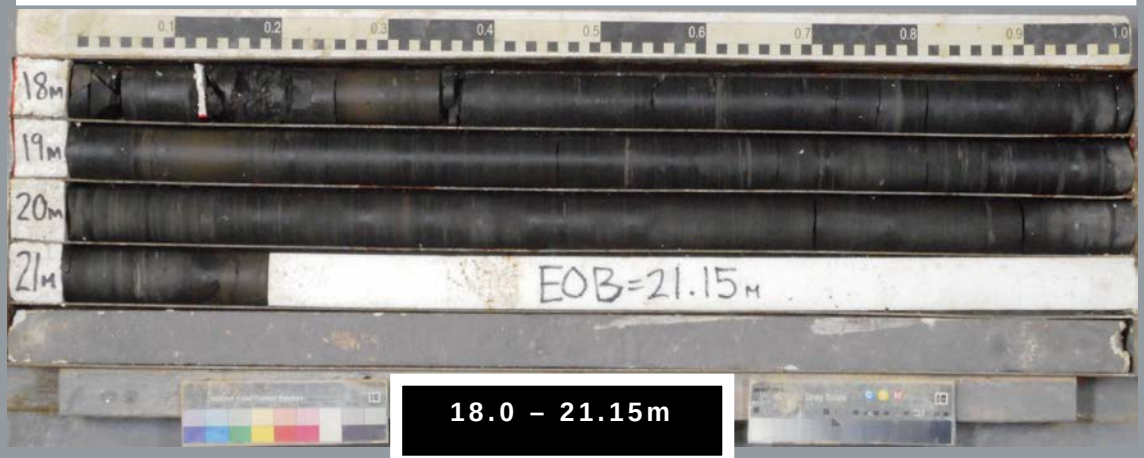
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 104 PROJECT 73946.02 JUN 2016



18.0 – 21.15m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.8 AHD
EASTING: 321647
NORTHING: 6252923
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 73946.02
DATE: 15/6/2016
SHEET 2 OF 3

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 - medium to high and high strength, fresh, slightly fractured then unbroken, grey laminite with approximately 20% fine sandstone laminations *(continued)*										PL(A) = 2.2
	11								C	100	100	
												PL(A) = 1.7
	12							>>				
												PL(A) = 1.2
	13								C	100	100	
												PL(A) = 0.8
	14											PL(A) = 1.2
								14.65m: J85°, pl, sm, cln				
	15											PL(A) = 1.3
	16							>>				
									C	100	100	PL(A) = 1
	16.8	SHALE - medium to high and medium strength, fresh, slightly fractured to unbroken, grey shale with some fine sandstone laminations										
	17											PL(A) = 1
								17.82m: J45°, pl, sm, cln				
	18	18.25m & 19.1m: very high strength siderite bands						18.02m: J45°, pl, sm, cln 18.14m: J35°, pl, sm, cly, sz, 50mm 18.5m: J70°, he/ti				PL(A) = 3.3 PL(A) = 0.7
	19								C	100	97	PL(A) = 5
	19.2	SHALE - high strength, fresh, unbroken, grey shale with some fine sandstone laminations										PL(A) = 1.2
								>>				

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Hand auger to 1.0m; Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 21.15m

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)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.8 AHD
EASTING: 321647
NORTHING: 6252923
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 73946.02
DATE: 15/6/2016
SHEET 3 OF 3

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
-2	21	SHALE - high strength, fresh, unbroken, grey shale with some fine sandstone laminations *(continued)*							C	100	97	PL(A) = 1.2
	21.15											PL(A) = 1
		Bore discontinued at 21.15m										
-3	22											
-4	23											
-5	24											
-6	25											
-7	26											
-8	27											
-9	28											
-10	29											
-11												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 4.0m

TYPE OF BORING: Hand auger to 1.0m; Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 21.15m

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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DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

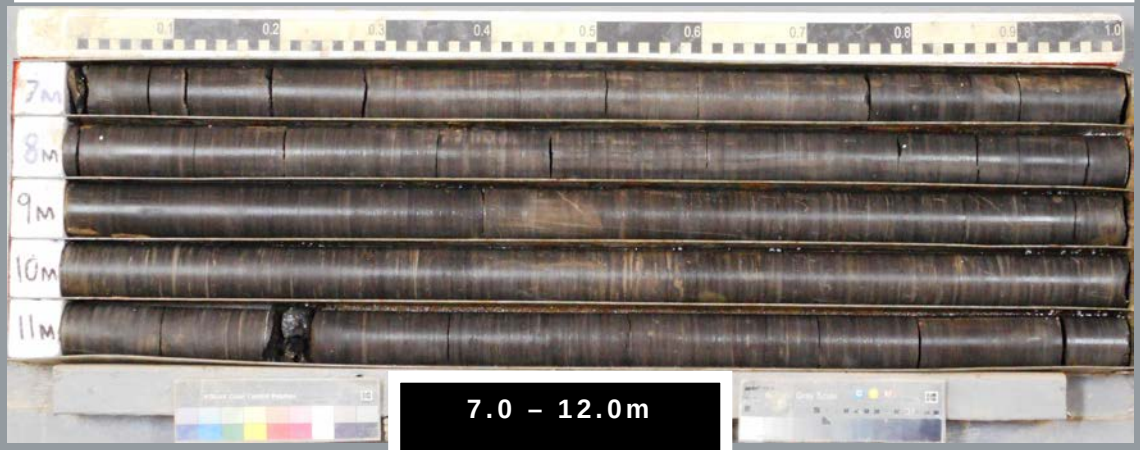
BORE 105 PROJECT 73946.02 JUN 2016

3.0 – 7.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 105 PROJECT 73946.02 JUN 2016



7.0 – 12.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.2 AHD
EASTING: 321658
NORTHING: 6252895
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 73946.02
DATE: 10/6/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Type	Core Rec. %	RQD %	Test Results & Comments
18	0.4	FILLING - brown, gravelly clayey medium to coarse grained sand filling (fine to medium sandstone and ironstone gravel), moist	A			
		FILLING - brown, silty clay filling with some fine to medium gravel (ironstone, shale and sandstone) and a trace of medium grained sand, moist	A			
17	1.1	0.7m: dark brown with a trace of charcoal	S			4,5,5 N = 10
		SILTY CLAY - stiff to very stiff, brown silty clay with a trace of medium ironstone gravel, charcoal and rootlets				
16	2.1	1.3m: grey and brown mottled				
		LAMINITE - very low strength, grey and brown laminite	S			30/120mm refusal
15	3.0	LAMINITE - low to medium strength, highly to moderately weathered, fractured, brown laminite with approximately 30% fine sandstone laminations and some clay seams				PL(A) = 0.4
14	4.0	LAMINITE - low to medium then low strength, moderately weathered, slightly fractured, grey-brown laminite with approximately 20% fine sandstone laminations	C	100	75	PL(A) = 0.3
13						PL(A) = 0.3
12	6.8	LAMINITE - high strength, fresh, unbroken, light grey to grey laminite with approximately 20% fine sandstone laminations				PL(A) = 5.2
11		- very high strength from 6.8m to 7.0m	C	100	89	PL(A) = 1.7
10						PL(A) = 1.2
9			C	100	100	PL(A) = 1.4

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

3.0-3.56m: B (x10) 0°, fe, cly, 2-5mm
3.5-3.6m: B (x5) 0°- 5°, cly, 5-10mm
3.73-3.75m: Cs
3.88-3.9m: Cs
4.35m: J45°- 90°, cu, ro, cly
4.72-4.85m: J55° & 80°, st, ro, fe
5.0, 5.75m: J70°, pl, ro, fe
5.3-5.4m: J75°, un, ro, fe
5.5-5.8m: J (x3) 70°, pl, ro, fe
6.05m: J50°- 70°, cu, ro, fe
6.2-6.36m: J80°, un, ro, fe
6.4-6.76m: J (x3) 45°- 70°, st, ro, ti
6.73m: B0°, cly, 10mm

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 21.25m

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
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 105 PROJECT 73946.02 JUN 2016

12.0 – 17.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 105 PROJECT 73946.02 JUN 2016

17.0 – 21.25m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.2 AHD
EASTING: 321658
NORTHING: 6252895
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 73946.02
DATE: 10/6/2016
SHEET 2 OF 3

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
8		LAMINITE - high strength, fresh, unbroken, light grey to grey laminite with approximately 20% fine sandstone laminations *(continued)*										PL(A) = 1.4
7	11							11.2m: B0°, ca	C	100	100	PL(A) = 1.6
6	12 12.0	SHALE - medium to high strength, fresh, slightly fractured then unbroken, grey shale with some fine sandstone laminations						12m: J85°, un, ro, cln 12.12m: J70°, un, ro, cln 12.35m: J45°, un, ro, cln				PL(A) = 0.9
5	13							12.82m: J70° & 45°, st, ro, cln 13m: J45°, pl, sm, cln 13.25m: J45°, pl, sm, cln	C	100	100	PL(A) = 1.5
4	14							14.2-14.35m: J75°, pl, ro, cln				PL(A) = 3.6
3	15	14.6m: very high strength siderite band										PL(A) = 1.2
2	16							>>	C	100	100	PL(A) = 0.7
1	17 17.0	SHALE - medium and high strength, fresh, slightly fractured and unbroken, grey shale										PL(A) = 6
0	18	17.8m: very high strength siderite band						17.7m: J45°, un, ro, cly, 20mm				PL(A) = 0.6
-1	19								C	100	100	PL(A) = 1.3

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 21.25m

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
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 18.2 AHD
EASTING: 321658
NORTHING: 6252895
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 73946.02
DATE: 10/6/2016
SHEET 3 OF 3

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
-2	21	SHALE - medium and high strength, fresh, slightly fractured and unbroken, grey shale *(continued)*						20.6m: B0°, ca, ti	C	100	100	PL(A) = 0.7
-3	21.25											PL(A) = 0.6
		Bore discontinued at 21.25m										
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI/KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 21.25m

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
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 106 PROJECT 73946.02 JUN 2016

3.0 – 7.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 106 PROJECT 73946.02 JUN 2016

7.0 – 12.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.0 AHD
EASTING: 321696
NORTHING: 6252844
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 73946.02
DATE: 8/6/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
13	0.07	ASPHALT							A			
	0.4	FILLING - grey, silty sandy fine to coarse igneous gravel filling, humid							A			
	0.6	FILLING - grey-brown, slightly silty, gravelly fine to coarse sand filling (fine to coarse grained sandstone and igneous gravel), humid							A			
12	1								S			12,19,30 N = 49
	1.3	SILTY CLAY - hard, grey mottled red-brown and orange-brown, silty clay with some fine grained sand and a trace of rootlets, moist										
		LAMINITE - extremely low strength, light grey and brown laminite										
11	2							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	2.5	LAMINITE - very low strength, grey and brown laminite with some extremely low and low strength bands							S			25,30/100mm refusal
10	3											
	3.0	LAMINITE - low and medium strength, highly weathered, highly fractured to fractured, brown and grey laminite						3.0-3.25m: fg, 50mm 3.07-3.16m: fg, 90mm 3.19m: J90°, pl ro, fe 3.26m: B0°, pl, cly, 10mm 3.4m: J75°, pl, ro, fe 3.43m: B0°, pl, cly, 6mm 3.48m: fg, 20mm 3.49m: J40°, pl, ro, fe 3.57m: B0°, cly, 20mm 3.61m: J75°, pl, ro, fe 3.69m: fg, 15mm 3.69m: J85°, pl, ro, fe 3.72m: B0°, pl, cly, 6mm 3.72m: J80°, un, ti 3.83m: B0°, cly, 5mm 3.85m: fg, 20mm 3.87m: J30°, pl, ro, cln 3.97m: fg, 30mm 4.1m: B0°, cly, 4mm 4.8m: B0°, cly, 1mm J60°, pl, ro, cln 5.24m: B0°, cly, 2mm 5.98m: B0°, pl, ro, cly vn 6.05m: J45°, pl, ro, cly, 5mm, fe 6.21-6.22m: J (x2) 45°, pl, ro, cly vn, fe 6.52m: J85°, un, ti	C	100	73	PL(A) = 0.2 PL(A) = 0.3 PL(A) = 1 PL(A) = 1.5
9	4											
	4.34	LAMINITE - high strength, moderately then slightly weathered, slightly fractured, grey and brown laminite										
8	5											
7	6											
	6.35	LAMINITE - medium to high and high strength, fresh, slightly fractured, grey laminite										
6	7								C	100	99	PL(A) = 1.4 PL(A) = 1.5
5	8							7.85m: J (x2) 35°, pl, ro, fe 7.95-8.07m: J (x5) 45°-50°, pl, ro, cln 8.5-8.1m: J (x2)°, 55°, pl, ro, cln				PL(A) = 2.3
4	9							8.9m: J (x3) 55°, pl, ro, cln				
									C	100	100	
								9.98m: J30°, pl, ro, cln				PL(A) = 1.1

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 15.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

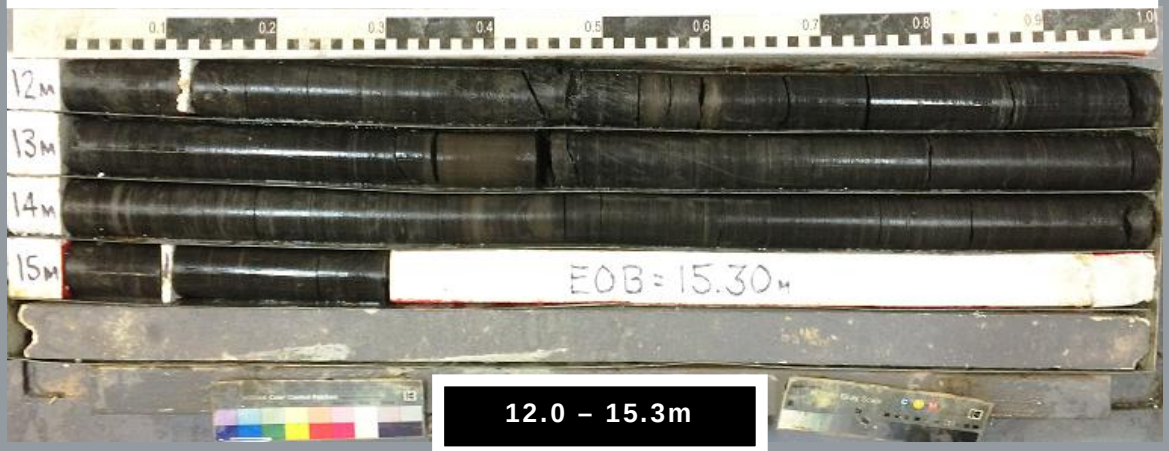
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample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

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 106 PROJECT 73946.02 JUN 2016



12.0 – 15.3m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.0 AHD
EASTING: 321696
NORTHING: 6252844
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 73946.02
DATE: 8/6/2016
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)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		LAMINITE - medium to high and high strength, fresh, slightly fractured, grey laminite *(continued)*										
2	11								C	100	100	PL(A) = 0.9
1	12							11.49m: J15°, pl, ro, cln				PL(A) = 0.8 PL(A) = 1
0	13							12.4m: B0°, pl, cly, 1mm 12.41m: J30°, pl, ro, cln 12.41m: J (x2) 75°- 85°, pl, ro, cln 12.46m: B0°, un, ro, cly, 3mm 12.55m: B0°, pl, ro, cly vn 13.3m: J30°, un, ro, cln 13.33m: J90°, un, ti 13.43m: B0°, un, ro, cly vn 13.46m: J10°, un, sm, cln	C	100	97	PL(A) = 1.4 PL(A) = 1.3
-1	14											
-2	15											
	15.3	Bore discontinued at 15.3m							C	100	100	PL(A) = 1.1
-3	16											
-4	17											
-5	18											
-6	19											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** KM **CASING:** HW to 2.5m; HQ to 3.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.0m; NMLC-Coring to 15.3m

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
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

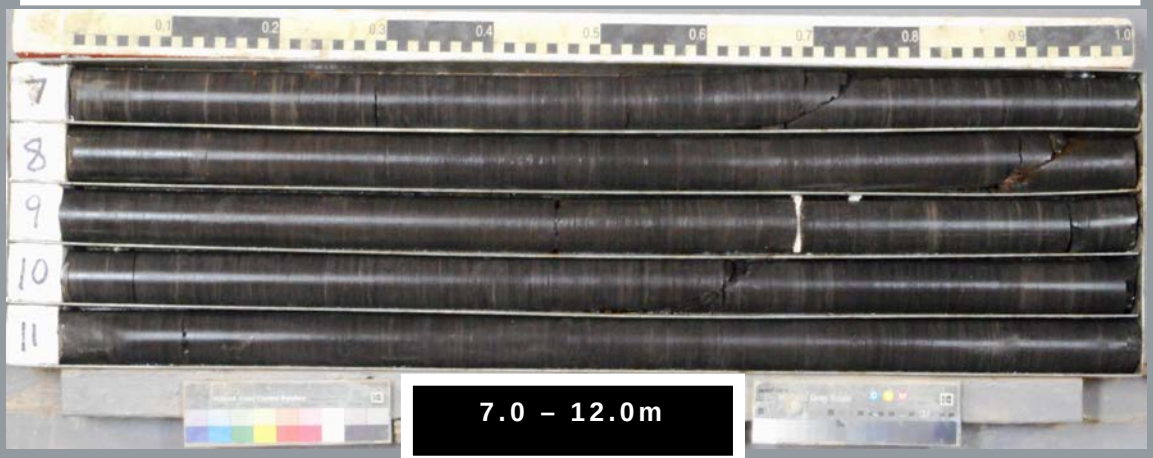
BORE 107 PROJECT 73946.02 JUN 2016

2.75 – 7.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 107 PROJECT 73946.02 JUN 2016



7.0 – 12.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.4 AHD
EASTING: 321715
NORTHING: 6252908
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 73946.02
DATE: 17/6/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
14	0.0	FILLING - dark grey and grey-brown, sandy clay and rubble filling, moist							A			
									A			
	0.7	SILTY CLAY - stiff, red-brown silty clay with a trace of ironstone gravel, moist							A			
13	1								S			3,4,6 N = 10
	1.7	SHALY CLAY - very stiff to hard, grey and brown shaly clay						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
12	2											
	2.2	LAMINITE - very low to low strength, light grey and brown laminite							S			25/100mm refusal
	3.0	LAMINITE - medium strength, highly to moderately weathered, fragmented to fractured, light grey and brown laminite with clay bands						2.75m: CORE LOSS: 250mm 3.0-3.35m: fg 3.55-3.4m: cly 3.4-4.1m: fg, cly, 10-20mm	C	90	0	PL(A) = 0.8
11	3											
	4							4.12m: J35°, pl, ro, cly 4.25-4.35m: J75°, un, ro, fe 4.3-4.6m: B0°, cly 4.75m: J60°, pl, ro, fe 4.83m: J25°, pl, ro, fe, cly 5.1m: J60°, pl, ro, cly, fe				PL(A) = 0.5
10	4.5	LAMINITE - medium strength, moderately weathered, fractured and slightly fractured, grey-brown laminite with approximately 20% fine sandstone laminations							C	100	72	
	5											PL(A) = 1.5
	5.5	LAMINITE - high strength, moderately weathered then fresh, slightly fractured and unbroken, brown then grey laminite with approximately 20% fine sandstone laminations						5.45-5.68m: J (x3) 70°, pl, ro, fe 5.82 & 5.9m: B0°, cly				
9	6											PL(A) = 1.5
	7											PL(A) = 1.3
8	7.5							7.65m: J70°, pl, ro, cln				
	8							8.12m: B0°, fe, cly	C	100	100	PL(A) = 1
6	8.5							8.85m: J70°, pl, ro, cln				
	9											PL(A) = 1
5	9.5							9.92m: J60°, pl, ro, cln	C	100	100	

RIG: DT-100 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 2.7m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.75m; NMLC-Coring to 16.55m

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)

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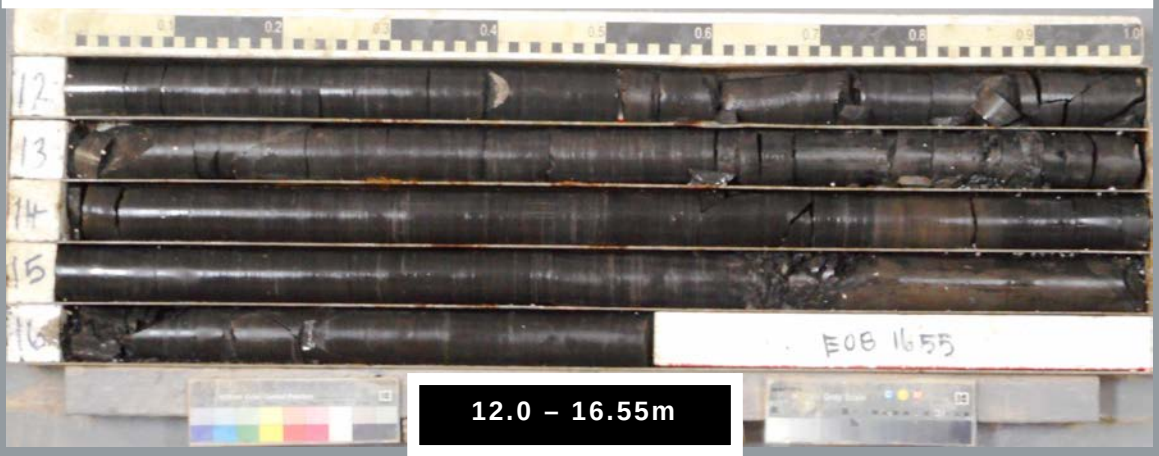
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 107 PROJECT 73946.02 JUN 2016



12.0 – 16.55m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 14.4 AHD
EASTING: 321715
NORTHING: 6252908
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 73946.02
DATE: 17/6/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		LAMINITE - high strength, moderately weathered then fresh, slightly fractured and unbroken, brown then grey laminite with approximately 20% fine sandstone laminations *(continued)*						10.55m: J70°, un, ro, Cz, 10mm	C	100	100	PL(A) = 1.6 PL(A) = 1.3
	12.0	SHALE - medium strength, fresh, fractured and slightly fractured, grey shale with some high strength siderite bands						12.35m: J70°, pl, sm, cln				PL(A) = 0.9
								12.85m: J70°, pl, sm, cln 12.9m: J90° & 60°, st, ro, cln 12.95m: J70°, pl, sm, cln 13.16m: J70°, pl, sm, cln 13.62m: J70°, pl, sm, cln 13.76m: J45°, pl, sm, cln 13.83-13.9m: Sz 14.6m: J60°, pl, sm, cln 14.65m: J45°, un, ro, cln	C	100	90	PL(A) = 0.9 PL(A) = 0.7 PL(A) = 2.6
								15.62-15.72m: Sz 15.72m: J70°, un, ro, cln 16m: J70° & 60°, st, sl, cln 16.15-16.55m: J (x4) 60°- 70°, pl, sm, ti	C	100	82	PL(A) = 0.7 PL(A) = 2.8 PL(A) = 0.6
	16.55	Bore discontinued at 16.55m										

RIG: DT-100 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 2.7m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.75m; NMLC-Coring to 16.55m

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)

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PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 108 PROJECT 73946.02 JUN 2016

2.7 – 6.0m

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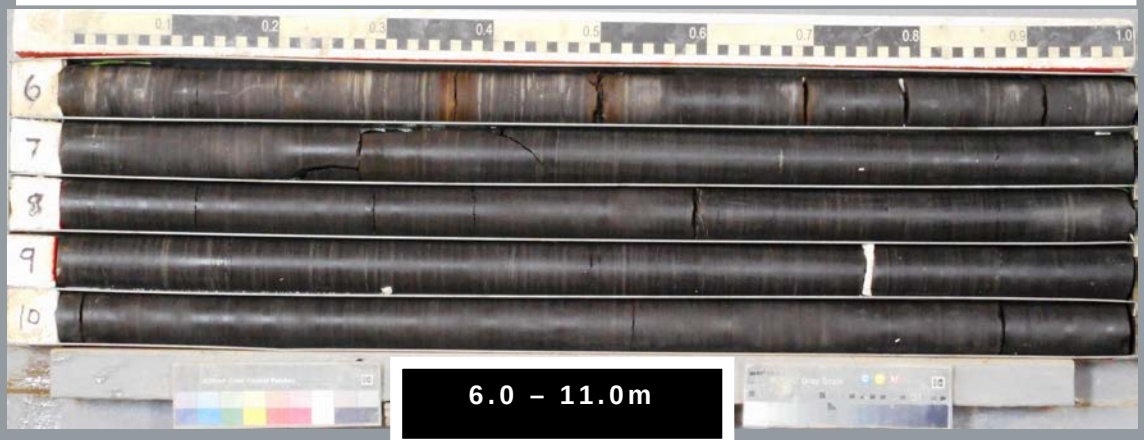
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 108 PROJECT 73946.02 JUN 2016



6.0 – 11.0m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.2 AHD
EASTING: 321724
NORTHING: 6252895
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 73946.02
DATE: 16/6/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
13	0	FILLING - dark grey sandy clay filling, moist							A			
12	1								A			
	1.4								S			2,3,3 N = 6
11	2	SILTY CLAY - firm to stiff, red-brown silty clay with a trace of ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	2.2	LAMINITE - very low strength, light grey laminite										
		2.5m: very low to low strength							S			25/130mm refusal
	2.7							2.7m: CORE LOSS: 240mm				
10	3							3.0-3.32m: fg				PL(A) = 0.9
	2.94	LAMINITE - medium strength, highly to moderately then moderately weathered, fragmented and fractured, grey-brown laminite with extremely low strength bands and clay bands						3.32, 3.37, 3.42m: B's 0°, cly, 5-20mm	C	82	25	
								3.47-3.55m: Cs				PL(A) = 0.5
9	4							3.55m: J, sv, pl, ro, cly				
								3.7-3.73m: Cs				
								3.8-3.82m: Cs				PL(A) = 1
								3.9 & 3.95m: B0°, cly co, 1-3mm				
								4.0 & 4.1m: Cs, 10mm				
								4.2m: J45°, pl, ro, fe				
								4.28 & 4.32m: Cs, 20mm & 10mm				
8	5							4.39m: J20°, un, ro, fe, cly inf, 10mm				
	5.0	LAMINITE - high then medium strength, moderately to fresh stained then fresh, slightly fractured then unbroken, light grey-brown to grey, laminite with approximately 20% fine sandstone laminations						4.62m: J60°- 70°, cu, ro, fe	C	100	70	PL(A) = 1.6
								4.81-4.85m: Sz, cly				
								5.13m: J45°, pl, ro, cln				
								5.45m: J, sv (85°), un, ro, cln				
	6							5.8-6.7m: B (x4) 0°, fe				PL(A) = 0.6
7	7											
								7.2m: J60°-90°, cu, sm, cln				
								7.42m: J45°, pl, sm, cln				PL(A) = 0.7
	8											
5	8.0	SHALE - medium and high strength, fresh, slightly fractured then unbroken, grey shale with some fine sandstone laminations							C	100	100	PL(A) = 1.3
								8.6-8.61m: h Sz				
	9											PL(A) = 1
4									C	100	100	

RIG: DT-100 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 2.6m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.7m; NMLC-Coring to 15.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 10.3m on 21/06/16

REMARKS: Standpipe installed to 15.25m (screen 9.25-15.25m; gravel 8.5-15.25m; bentonite 7.5-8.5m; backfill to GL with stick-up 0.5m)

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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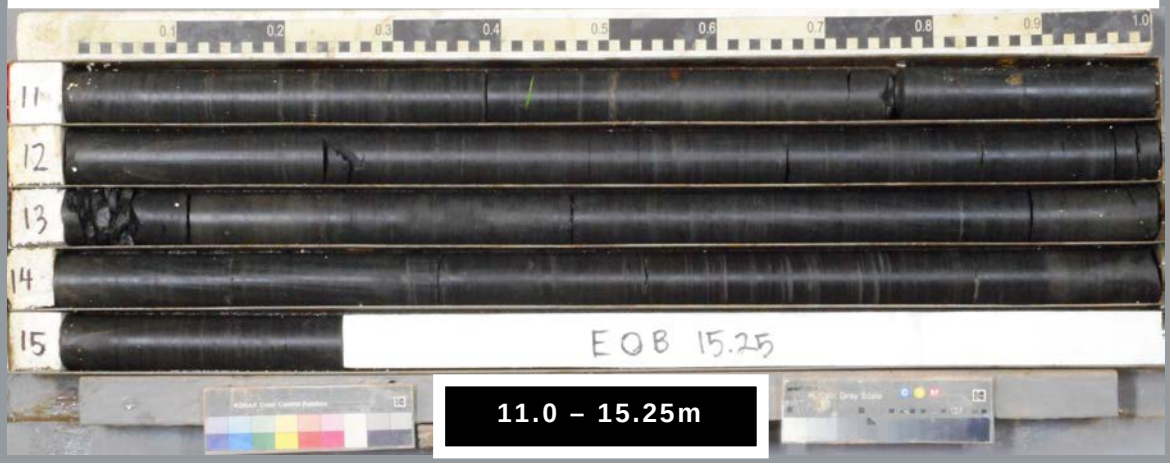
PROPOSED RESIDENTIAL DEVELOPMENT – SYDNEY OLYMPIC PARK

BORE 108 PROJECT 73946.02 JUN 2016



11.0 – 15.25m

BOREHOLE LOG

CLIENT: Mirvac Projects Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 2 Figtree Drive, Sydney Olympic Park

SURFACE LEVEL: 13.2 AHD
EASTING: 321724
NORTHING: 6252895
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 73946.02
DATE: 16/6/2016
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)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
3	11	SHALE - medium and high strength, fresh, slightly fractured then unbroken, grey shale with some fine sandstone laminations *(continued)*				21-06-16		>>				PL(A) = 1.1
2									C	100	100	
1	12							12.06-12.15m: J75°, he/ti 12.25m: J70°, pl, ro, cln				PL(A) = 0.6 PL(A) = 0.7
0	13											PL(A) = 0.6
-1	14								C	100	97	PL(A) = 1.1
-2	15											PL(A) = 0.7
	15.25	Bore discontinued at 15.25m										
-3	16											
-4	17											
-5	18											
-6	19											

RIG: DT-100 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 2.6m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 2.7m; NMLC-Coring to 15.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 10.3m on 21/06/16

REMARKS: Standpipe installed to 15.25m (screen 9.25-15.25m; gravel 8.5-15.25m; bentonite 7.5-8.5m; backfill to GL with stick-up 0.5m)

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

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Permeability Testing - Simple Slug Test Report

Client:	Mirvac Projects Pty Ltd	Project No:	73946.02
Project:	Proposed Residential Development	Date:	21-Jun-16
Location:	2 Figtree Drive, Sydney Olympic Park	Tested by:	KM

Test Location

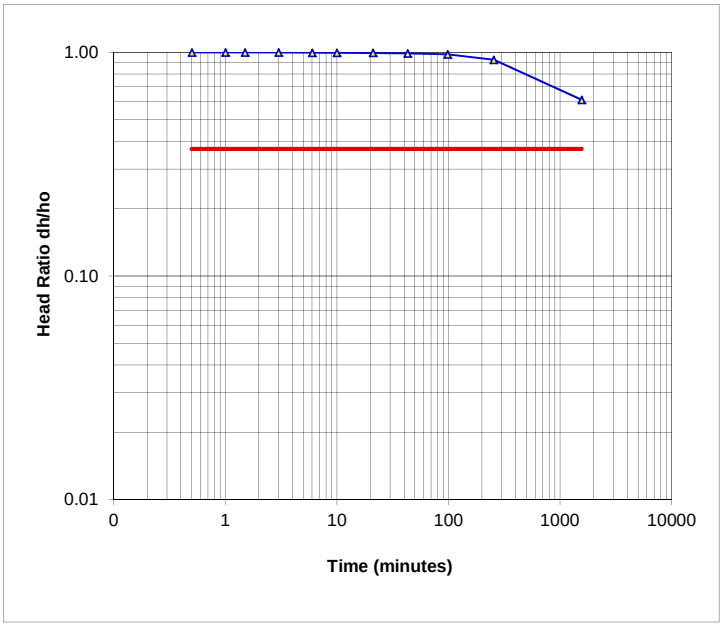
Description:	BH101	**Test No.**	Drawdown 1	
Material type:	Shale/Laminite	Easting:	321608	m
		Northing	6252887	m
		Surface Level:	20.1	m AHD

Details of Well Installation

Well casing diameter	76	mm	Depth to water before test	8.08	m
Well screen diameter	50	mm	Depth to water at start of test	16.22	m
Length of well screen	6	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0	16.22	8.14	1.000
0.5	16.22	8.14	1.000
1	16.21	8.13	0.999
2	16.21	8.13	0.999
3	16.21	8.13	0.999
6	16.2	8.12	0.998
10	16.2	8.12	0.998
21	16.18	8.10	0.995
43	16.14	8.06	0.990
98	16.05	7.97	0.979
254.5	15.62	7.54	0.926
1557	13.08	5	0.614



To = 18000 mins
1080000 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity **k =** **6.1E-10** m/sec
= **0.000** cm/hour

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Permeability Testing - Simple Slug Test Report

Client:	Mirvac Projects Pty Ltd	Project No:	73946.02
Project:	Proposed Residential Development	Date:	21-Jun-16
Location:	2 Figtree Drive, Sydney Olympic Park	Tested by:	KM

Test Location

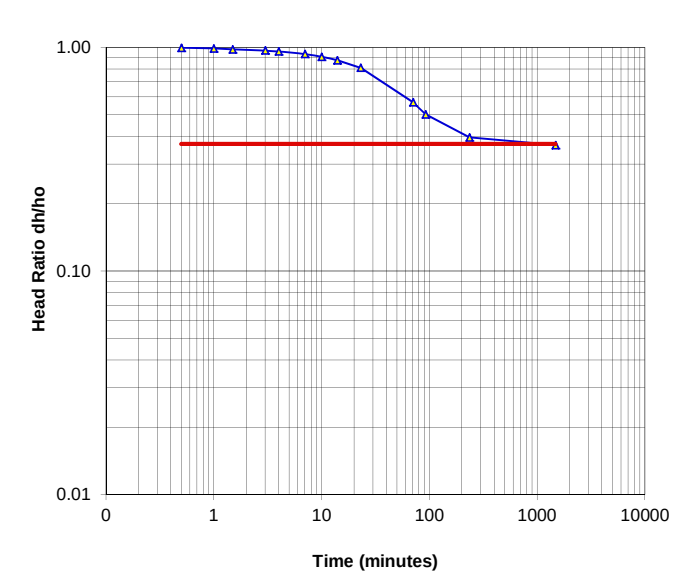
Description:	BH103	**Test No.**	Drawdown 1	
Material type:	Shale/Laminite	Easting:	321663	m
		Northing	6252818	m
		Surface Level:	13.3	m AHD

Details of Well Installation

Well casing diameter	76	mm	Depth to water before test	4.36	m
Well screen diameter	50	mm	Depth to water at start of test	11.98	m
Length of well screen	6	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0	11.98	7.62	1.000
0.5	11.95	7.59	0.996
1	11.9	7.54	0.990
2	11.82	7.46	0.979
3	11.74	7.38	0.969
4	11.67	7.31	0.959
7	11.48	7.12	0.934
10	11.28	6.92	0.908
14	11.04	6.68	0.877
23	10.54	6.18	0.811
70.5	8.69	4.33	0.568
92	8.19	3.83	0.503
235	7.38	3.02	0.396
1484	7.15	2.79	0.366



To = 800 mins
48000 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.4E-08**	m/sec
	=	**0.005**	cm/hour

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Permeability Testing - Simple Slug Test Report

Client:	Mirvac Projects Pty Ltd	Project No:	73946.02
Project:	Proposed Residential Development	Date:	21-Jun-16
Location:	2 Figtree Drive, Sydney Olympic Park	Tested by:	KM

Test Location

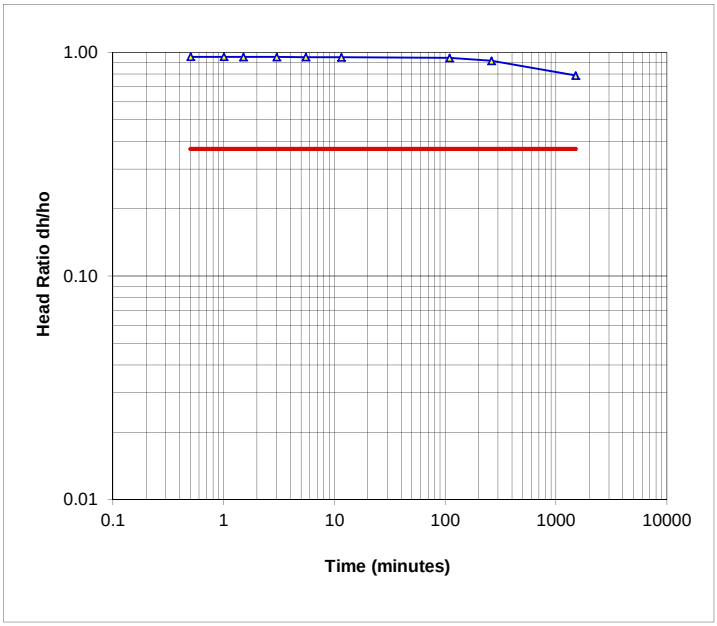
Description:	BH108	**Test No.**	Drawdown 1	
Material type:	Shale/Laminite	Easting:	321724	m
		Northing	6252887	m
		Surface Level:	13.2	m AHD

Details of Well Installation

Well casing diameter	76	mm	Depth to water before test	2.86	m
Well screen diameter	50	mm	Depth to water at start of test	14.28	m
Length of well screen	6	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0	13.79	10.93	0.957
0.5	13.78	10.92	0.956
1	13.78	10.92	0.956
1.5	13.77	10.91	0.955
3	13.76	10.90	0.954
5.5	13.74	10.88	0.953
11.5	13.72	10.86	0.951
109	13.66	10.80	0.946
260.5	13.35	10.49	0.919
1503	11.86	9.00	0.788



To = 100000 mins
6000000 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity **k = 1.1E-10** m/sec
= 0.000 cm/hour

Appendix E

Results of Laboratory Testing

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 149038

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kelly McPhee, Peter Oitmaa

Sample log in details:

Your Reference:	**73946.02, Sydney Olympic Park**
No. of samples:	3 Waters
Date samples received / completed instructions received	24/06/2016 / 24/06/2016

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	1/07/16 / 1/07/16
Date of Preliminary Report:	Not Issued

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	149038-1 BH101 24/06/2016 Water	149038-2 BH103 22/06/2016 Water	149038-3 BH108 24/06/2016 Water
Date extracted	-	28/06/2016	27/06/2016	27/06/2016
Date analysed	-	29/06/2016	28/06/2016	28/06/2016
Dichlorodifluoromethane	µg/L	<10	<10	<10
Chloromethane	µg/L	<10	<10	<10
Vinyl Chloride	µg/L	<10	<10	<10
Bromomethane	µg/L	<10	<10	<10
Chloroethane	µg/L	<10	<10	<10
Trichlorofluoromethane	µg/L	<10	<10	<10
1,1-Dichloroethene	µg/L	<1	<1	<1
Trans-1,2-dichloroethene	µg/L	<1	<1	<1
1,1-dichloroethane	µg/L	<1	<1	<1
Cis-1,2-dichloroethene	µg/L	<1	<1	<1
Bromochloromethane	µg/L	<1	<1	<1
Chloroform	µg/L	8	9	9
2,2-dichloropropane	µg/L	<1	<1	<1
1,2-dichloroethane	µg/L	<1	<1	<1
1,1,1-trichloroethane	µg/L	<1	<1	<1
1,1-dichloropropene	µg/L	<1	<1	<1
Cyclohexane	µg/L	<1	<1	<1
Carbon tetrachloride	µg/L	<1	<1	<1
Benzene	µg/L	<1	<1	<1
Dibromomethane	µg/L	<1	<1	<1
1,2-dichloropropane	µg/L	<1	<1	<1
Trichloroethene	µg/L	<1	<1	<1
Bromodichloromethane	µg/L	7	7	9
trans-1,3-dichloropropene	µg/L	<1	<1	<1
cis-1,3-dichloropropene	µg/L	<1	<1	<1
1,1,2-trichloroethane	µg/L	<1	<1	<1
Toluene	µg/L	<1	<1	<1
1,3-dichloropropane	µg/L	<1	<1	<1
Dibromochloromethane	µg/L	7	7	7
1,2-dibromoethane	µg/L	<1	<1	<1
Tetrachloroethene	µg/L	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	<1	<1	<1
Chlorobenzene	µg/L	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1
Bromoform	µg/L	2	1	1
m+p-xylene	µg/L	<2	<2	<2
Styrene	µg/L	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	<1	<1	<1
o-xylene	µg/L	<1	<1	<1

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ----------	149038-1 BH101 24/06/2016 Water	149038-2 BH103 22/06/2016 Water	149038-3 BH108 24/06/2016 Water
1,2,3-trichloropropane	µg/L	<1	<1	<1
Isopropylbenzene	µg/L	<1	<1	<1
Bromobenzene	µg/L	<1	<1	<1
n-propyl benzene	µg/L	<1	<1	<1
2-chlorotoluene	µg/L	<1	<1	<1
4-chlorotoluene	µg/L	<1	<1	<1
1,3,5-trimethyl benzene	µg/L	<1	<1	<1
Tert-butyl benzene	µg/L	<1	<1	<1
1,2,4-trimethyl benzene	µg/L	<1	<1	<1
1,3-dichlorobenzene	µg/L	<1	<1	<1
Sec-butyl benzene	µg/L	<1	<1	<1
1,4-dichlorobenzene	µg/L	<1	<1	<1
4-isopropyl toluene	µg/L	<1	<1	<1
1,2-dichlorobenzene	µg/L	<1	<1	<1
n-butyl benzene	µg/L	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	<1	<1	<1
Hexachlorobutadiene	µg/L	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	<1	<1	<1
Surrogate Dibromofluoromethane	%	97	104	105
Surrogate toluene-d8	%	95	99	99
Surrogate 4-BFB	%	98	110	105

vTRH in Water (C6-C9) NEPM				
Our Reference:	UNITS	149038-1	149038-2	149038-3
Your Reference	----------	BH101	BH103	BH108
	-			
Date Sampled	----------	24/06/2016	22/06/2016	24/06/2016
Type of sample		Water	Water	Water
Date extracted	-	28/06/2016	27/06/2016	27/06/2016
Date analysed	-	29/06/2016	28/06/2016	28/06/2016
TRHC6 - C9	µg/L	14	12	14
TRHC6 - C10	µg/L	14	13	16
Surrogate Dibromofluoromethane	%	97	104	105
Surrogate toluene-d8	%	95	99	99
Surrogate 4-BFB	%	98	110	105

svTRH (C10-C40) in Water				
Our Reference:	UNITS	149038-1	149038-2	149038-3
Your Reference	----------	BH101	BH103	BH108
	-			
Date Sampled	----------	24/06/2016	22/06/2016	24/06/2016
Type of sample		Water	Water	Water
Date extracted	-	29/06/2016	29/06/2016	29/06/2016
Date analysed	-	29/06/2016	29/06/2016	29/06/2016
$TRHC_{10}$ - C_{14}	µg/L	<50	<50	<50
$TRHC_{15}$ - C_{28}	µg/L	490	<100	<100
$TRHC_{29}$ - C_{36}	µg/L	<100	<100	<100
$TRH>C_{10}$ - C_{16}	µg/L	<50	<50	<50
$TRH>C_{16}$ - C_{34}	µg/L	480	<100	<100
$TRH>C_{34}$ - C_{40}	µg/L	<100	<100	<100
Surrogate o-Terphenyl	%	103	103	105

HM in water - dissolved				
Our Reference:	UNITS	149038-1	149038-2	149038-3
Your Reference	----------	BH101	BH103	BH108
	-			
Date Sampled	----------	24/06/2016	22/06/2016	24/06/2016
Type of sample		Water	Water	Water
Date prepared	-	27/06/2016	27/06/2016	27/06/2016
Date analysed	-	27/06/2016	27/06/2016	27/06/2016
Arsenic-Dissolved	µg/L	2	3	2
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1
Copper-Dissolved	µg/L	9	2	2
Lead-Dissolved	µg/L	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	3	5	7
Zinc-Dissolved	µg/L	44	21	30
Iron-Dissolved	µg/L	<10	<10	<10

Phthalates in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	149038-1 BH101 24/06/2016 Water	149038-2 BH103 22/06/2016 Water	149038-3 BH108 24/06/2016 Water
Date extracted	-	29/06/2016	29/06/2016	29/06/2016
Date analysed	-	30/06/2016	30/06/2016	30/06/2016
Bis(2-ethylhexyl) phthalate	µg/L	400	<50	<50
Butylbenzylphthalate	µg/L	<10	<10	<10
Diethylphthalate	µg/L	<10	<10	<10
Dimethyl phthalate	µg/L	<10	<10	<10
Di-n-butylphthalate	µg/L	<50	<50	<50
Di-n-octylphthalate	µg/L	<10	<10	<10
Surrogate Nitrobenzene-d_5	%	80	86	90
Surrogate 2-fluorobiphenyl	%	84	86	92
Surrogate 2,4,6-Tribromophenol	%	86	92	87
Surrogate *p*-Terphenyl-d_{14}	%	117	91	84

Miscellaneous Inorganics				
Our Reference:	UNITS	149038-1	149038-2	149038-3
Your Reference	----------	BH101	BH103	BH108
	-			
Date Sampled	----------	24/06/2016	22/06/2016	24/06/2016
Type of sample		Water	Water	Water
Date prepared	-	27/06/2016	27/06/2016	27/06/2016
Date analysed	-	27/06/2016	27/06/2016	27/06/2016
Ammonia as N in water	mg/L	0.35	0.16	0.38

Method ID	Methodology Summary
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			28/06/2016	149038-2	27/06/2016 || 28/06/2016	LCS-W1	27/06/2016
Date analysed	-			29/06/2016	149038-2	28/06/2016 || 29/06/2016	LCS-W1	28/06/2016
Dichlorodifluoromethane	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
Chloromethane	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
Vinyl Chloride	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
Bromomethane	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
Chloroethane	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
Trichlorofluoromethane	µg/L	10	Org-013	<10	149038-2	<10 || <10	[NR]	[NR]
1,1-Dichloroethene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Trans-1,2-dichloroethene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,1-dichloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	LCS-W1	97%
Cis-1,2-dichloroethene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Bromochloromethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Chloroform	µg/L	1	Org-013	<1	149038-2	9 || 9 || RPD: 0	LCS-W1	99%
2,2-dichloropropane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2-dichloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	LCS-W1	96%
1,1,1-trichloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	LCS-W1	104%
1,1-dichloropropene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Cyclohexane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Carbon tetrachloride	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Dibromomethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2-dichloropropane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Trichloroethene	µg/L	1	Org-013	<1	149038-2	<1 || <1	LCS-W1	106%
Bromodichloromethane	µg/L	1	Org-013	<1	149038-2	7 || 7 || RPD: 0	LCS-W1	95%
trans-1,3-dichloropropene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
cis-1,3-dichloropropene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,1,2-trichloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Toluene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,3-dichloropropane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Dibromochloromethane	µg/L	1	Org-013	<1	149038-2	7 || 6 || RPD: 15	LCS-W1	93%
1,2-dibromoethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Tetrachloroethene	µg/L	1	Org-013	<1	149038-2	<1 || <1	LCS-W1	103%
1,1,1,2-tetrachloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Chlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Ethylbenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Bromoform	µg/L	1	Org-013	<1	149038-2	1 || 1 || RPD: 0	[NR]	[NR]
m+p-xylene	µg/L	2	Org-013	<2	149038-2	<2 || <2	[NR]	[NR]
Styrene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,1,2,2-tetrachloroethane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
o-xylene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
1,2,3-trichloropropane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Isopropylbenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Bromobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
n-propyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
2-chlorotoluene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
4-chlorotoluene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,3,5-trimethyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Tert-butyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2,4-trimethyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,3-dichlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Sec-butyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,4-dichlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
4-isopropyl toluene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2-dichlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
n-butyl benzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2-dibromo-3-chloropropane	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2,4-trichlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Hexachlorobutadiene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
1,2,3-trichlorobenzene	µg/L	1	Org-013	<1	149038-2	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-013	103	149038-2	104 || 99 || RPD: 5	LCS-W1	99%
Surrogate toluene-d8	%		Org-013	97	149038-2	99 || 95 || RPD: 4	LCS-W1	100%
Surrogate 4-BFB	%		Org-013	97	149038-2	110 || 96 || RPD: 14	LCS-W1	90%

QUALITY CONTROL vTRH in Water (C6-C9) NEPM	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/06/2016	149038-2	27/06/2016 || 28/06/2016	LCS-W1	27/06/2016
Date analysed	-			28/06/2016	149038-2	28/06/2016 || 29/06/2016	LCS-W1	28/06/2016
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	149038-2	12 || 11 || RPD: 9	LCS-W1	96%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	149038-2	13 || 11 || RPD: 17	LCS-W1	96%
Surrogate Dibromofluoromethane	%		Org-016	99	149038-2	104 || 99 || RPD: 5	LCS-W1	99%
Surrogate toluene-d8	%		Org-016	98	149038-2	99 || 95 || RPD: 4	LCS-W1	100%
Surrogate 4-BFB	%		Org-016	100	149038-2	110 || 96 || RPD: 14	LCS-W1	90%
QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/06/2016	[NT]	[NT]	LCS-W4	29/06/2016
Date analysed	-			29/06/2016	[NT]	[NT]	LCS-W4	29/06/2016
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W4	81%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W4	100%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W4	115%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W4	81%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W4	100%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W4	115%
Surrogate o-Terphenyl	%		Org-003	103	[NT]	[NT]	LCS-W4	117%
QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/06/2016	[NT]	[NT]	LCS-W2	27/06/2016
Date analysed	-			27/06/2016	[NT]	[NT]	LCS-W2	27/06/2016
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	96%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	[NT]	[NT]	LCS-W2	101%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	91%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	94%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	105%
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	LCS-W2	89%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	96%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W2	96%
Iron-Dissolved	µg/L	10	Metals-022 ICP-MS	<10	[NT]	[NT]	LCS-W2	97%

QUALITY CONTROL Phthalates in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/06/2016	[NT]	[NT]	LCS-W3	29/06/2016
Date analysed	-			30/06/2016	[NT]	[NT]	LCS-W3	30/06/2016
Bis(2-ethylhexyl) phthalate	µg/L	50	Org-012	<50	[NT]	[NT]	[NR]	[NR]
Butylbenzylphthalate	µg/L	10	Org-012	<10	[NT]	[NT]	[NR]	[NR]
Diethylphthalate	µg/L	10	Org-012	<10	[NT]	[NT]	LCS-W3	87%
Dimethyl phthalate	µg/L	10	Org-012	<10	[NT]	[NT]	LCS-W3	78%
Di-n-butylphthalate	µg/L	50	Org-012	<50	[NT]	[NT]	[NR]	[NR]
Di-n-octylphthalate	µg/L	10	Org-012	<10	[NT]	[NT]	[NR]	[NR]
Surrogate Nitrobenzene-d_5	%		Org-012	73	[NT]	[NT]	LCS-W3	74%
Surrogate 2-fluorobiphenyl	%		Org-012	69	[NT]	[NT]	LCS-W3	81%
Surrogate 2,4,6-Tribromophenol	%		Org-012	77	[NT]	[NT]	LCS-W3	81%
Surrogate p-Terphenyl-d_{14}	%		Org-012	95	[NT]	[NT]	LCS-W3	88%
QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/06/2016	[NT]	[NT]	LCS-W1	27/06/2016
Date analysed	-			27/06/2016	[NT]	[NT]	LCS-W1	27/06/2016
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	[NT]	[NT]	LCS-W1	98%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.