



E	ISSUE FOR DA	CR	AWI	00.01.15	NORTH POINT	 THE UNIVERSITY OF SYDNEY CONSTRUCTIONS	 RICHARD CROOKES ARCHITECTS	 RICE DAUBNEY ARCHITECTS	PROJECT: LEES1 BUILDING SYDNEY UNIVERSITY SYDNEY, NSW, 2006	DRAWING TITLE: SECTION 2	SCALE:	1:200 @ A2	CHECKED:	SS
	REV	DISCUSSION OF CHANGE	CR	AWI							00.01.15	PROJECT NUMBER:	15H	DRAWING NUMBER:
<small>THE DOCUMENT IS THE COPYRIGHT OF RICE DAUBNEY GROUP (RDG) PTY. LTD. NO PART OF THIS DOCUMENT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF RICE DAUBNEY GROUP (RDG) PTY. LTD.</small>														

Appendix B

Borehole Logs
& Notes 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.

Copyright

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

Borehole and Test Pit Logs

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

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

Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

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

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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



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

Sampling Methods

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

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



Description and Classification Methods

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

Soil Types

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

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

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

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

The proportions of secondary constituents of soils are described as:

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

Definitions of grading terms used are:

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

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Descriptions

Soil Origin

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

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

Transported soils may be further subdivided into:

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



Rock Strength

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

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Degree of Fracturing

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

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

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners



Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough





Other

fg	fragmented
bnd	band
qtz	quartz



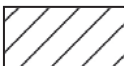
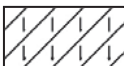
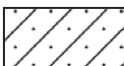



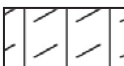


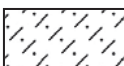





Symbols & Abbreviations

Graphic Symbols for Soil and Rock




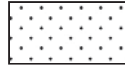
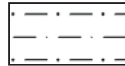
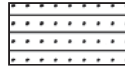



General

	Asphalt
	Road base
	Concrete
	Filling

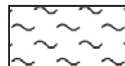
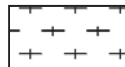
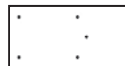
Soils

	Topsoil
	Peat
	Clay
	Silty clay
	Sandy clay
	Gravelly clay
	Shaly clay
	Silt
	Clayey silt
	Sandy silt
	Sand
	Clayey sand
	Silty sand
	Gravel
	Sandy gravel
	Cobbles, boulders
	Talus

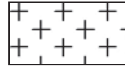


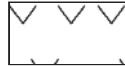

Sedimentary Rocks

	Boulder conglomerate
	Conglomerate
	Conglomeratic sandstone
	Sandstone
	Siltstone
	Laminite
	Mudstone, claystone, shale
	Coal
	Limestone

Metamorphic Rocks

	Slate, phyllite, schist
	Gneiss
	Quartzite

Igneous Rocks

	Granite
	Dolerite, basalt, andesite
	Dacite, epidote
	Tuff, breccia
	Porphyry

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carslaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.3 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 6A
PROJECT No: 84897.04
DATE: 4/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
33	0.0	FILLING - dark brown, silty sand filling with trace igneous gravel and rootlets	[Cross-hatched pattern]	E	0.0					
	0.1									
	0.2	FILLING - dark brown, silty clay filling with trace angular igneous gravel and rootlets		E	0.2					
	0.3									
	0.4			E	0.4					
0.5	Bore discontinued at 0.5m - refusal on stiff clay		E	0.5						
1										
32										

RIG: Hand tools **DRILLER:** RJL **LOGGED:** RJL **CASING:** Uncased
TYPE OF BORING: Hand auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: ^Surface level interpolated from drawing "Consolidated Services Bound" provided by the client

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 _s 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)



BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carslaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.8 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 84897.04
DATE: 4/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	FILLING - dark brown, clayey sand filling with trace angular igneous gravel, rootlets and grass (topsoil)		E	0.0					
		FILLING - dark brown, sandy clay filling with trace igneous gravel, ash, slag and glass			0.1					
					0.2					
	0.3	FILLING - dark grey, gravelly sand filling with some ash, slag and clinker		E	0.3					
					0.4					
	0.5	FILLING - brown clay filling with trace igneous gravel and ironstone gravel			0.5					
					0.6					
					0.7					
	0.8	CLAY - brown-orange clay with trace ironstone gravel		E	0.8					
					0.9					
1	1.0	Bore discontinued at 1.0m - target depth reached								

RIG: Hand tools

DRILLER: RJL

LOGGED: RJL

CASING: Uncased

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ^Surface level interpolated from drawing "Consolidated Services Bound" provided by the client

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

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carslaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.8 AHD[^]
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 84897.04
DATE: 4/5/2016
SHEET 1 OF 1

R/L	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	FILLING - dark brown, clayey sand filling with trace angular igneous gravel and grass (topsoil)	X	E	0.0					
	0.1	FILLING - dark brown, sandy clay filling with some sandstone gravel and trace slag and ceramic tile	X		0.1					
	0.2		X		0.2					
	0.3		X	E*	0.3					
	0.4	FILLING - dark grey, gravelly sand filling with trace clinker and slag	X	E	0.4					
	0.5	FILLING - brown clay filling with trace angular igneous gravel	X		0.5					
	0.55	FILLING - brown sandy clay filling with trace igneous gravel	X		0.55					
	0.6		X	E	0.6					
	0.7		X		0.7					
	0.9		X		0.9					
	1.0		X	E	1.0					
	1.1	CLAY - light grey mottled orange clay	X	E	1.1					
	1.2		X		1.2					
	1.3	Bore discontinued at 1.3m - target depth reached								

RIG: Hand tools

DRILLER: RJL

LOGGED: RJL

CASING: Uncased

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: [^]Surface level interpolated from drawing "Consolidated Services Bound" provided by the client
 *BD2-040516 is blind replicate sample from 0.2m to 0.3m

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

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carlsaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 34.1 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 84897.04
DATE: 4/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
34	0.1	FILLING - brown, clayey sand filling with trace angular igneous gravel, rootlets and grass (topsoil)	[Cross-hatched pattern]	E	0.0					
		FILLING - brown, sandy clay with some ironstone gravel, trace igneous gravel and slag			0.1					
		E		0.2						
		E		0.3						
		E		0.4						
	0.5	Bore discontinued at 0.5m - refusal on gravel			0.5					
1										
33										

RIG: Hand tools **DRILLER:** RJL **LOGGED:** RJL **CASING:** Uncased
TYPE OF BORING: Hand auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: ^Surface level interpolated from drawing "Consolidated Services Bound" provided by the client

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 _s 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	sp Standard penetration test
E Environmental sample	≡ Water level	V Shear vane (kPa)



BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carslaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 84897
DATE: 30/6/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing													
			EW	HW	MW	SW	FR		Ex Low	Very Low	Low	Medium	High			Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding	J - Joint	S - Shear	F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments	
33.5	0.7	FILLING - light grey to dark grey, silty clay filling with some gravel (roadbase) and grass at top																					A				3,3,5 N = 8				
32.8	1.0	CLAY - stiff, orange-brown to red-brown clay, slightly silty, with a trace of ironstone gravel, moist																					A/E								
32.0	2.0	SHALE - extremely low to very low strength, light grey shale																					S								
31.0	2.0	SHALE - extremely low to very low strength, light grey shale																					E				14,25/100mm refusal				
30.0	3.0	SHALE - extremely low to very low strength, light grey shale																					S								
29.0	4.0	SHALE - extremely low to very low strength, highly weathered, fractured, light grey-brown shale with medium strength ironstone bands																	4.0-4.3m: B's 0°, cly, fe									PL(A) = 0.3			
28.0	4.35	SHALE - low to medium strength, highly to moderately then slightly weathered, fractured and slightly fractured, grey-brown shale with some extremely low to very low strength bands																	4.58m: J, sv, pl, ro, fe 4.66m: J85° & 70°, st, ro, cln 4.85m: J, sv, pl, ro, fe 5.05m: J, sv, un, ro, cln 5.23-5.3m: Cs 5.31m: J70°, pl, ro, cln 5.4m: J30°, un, ro, fe 5.6m: J30°, pl, ro, fe, cly 5.83m: J90°, un, ro, cln 5.93-6.33m: B (x3) 0°, fe		100	45									
27.0	6.0	LAMINITE - medium then high strength, slightly weathered, slightly fractured, grey to grey-brown, laminite with approximately 20% fine sandstone laminations																	6.5m: J70° & 85°, st, ro, fe 6.62-6.66m: Cs 6.72 & 6.94m: B's 5°, fe 7m: J45°, pl, sm, fe 7.2m: B0°, fe, Cz, 5mm 7.3-7.4m: Cs					C	100	88					PL(A) = 0.7
26.0	7.0	LAMINITE - medium then high strength, slightly weathered, slightly fractured, grey to grey-brown, laminite with approximately 20% fine sandstone laminations																	7.7m: J35°, pl, ro, fe									PL(A) = 1.2			
25.0	8.0	Bore discontinued at 8.0m																													

RIG: Bobcat **DRILLER:** SY **LOGGED:** SI **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 8.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test fs(50) (MPa)
		PL(D)	Point load diametral test fs(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: LEES1 Carslaw Extension
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 35.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 84897
DATE: 29/6/2015
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 0.01 0.05 0.10 0.50 1.00	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing										
								B - Bedding S - Shear	J - Joint F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments							
35	0.1	PAVERS																		
	0.4	FILLING - light grey, fine to medium sand filling with some concrete gravel, humid									A									
	1	FILLING - apparently poorly compacted, light grey and grey, silty clay filling with some sand and crushed shale fragments, moist									A/E									
	1.3	SILTY CLAY - stiff, brown, silty clay with ironstone gravel, moist									A/E									3,5.6 N = 11
	2.0	SHALE/LAMINITE - very low strength, light grey to grey, shale/laminite									S									
	2										E									
	3										E									
	4										S									17,25/100mm refusal
	4.1	LAMINITE - alternate bands of extremely low to very low and low strength, extremely to highly weathered, fragmented to fractured, grey-brown laminite																		
	5																			
	6																			
	6.7	LAMINITE - high strength, moderately then slightly weathered, slightly fractured, grey-brown, laminite with approximately 25% fine sandstone laminations																		
	7																			
	8.0	Bore discontinued at 8.0m																		
	9																			

RIG: Bobcat **DRILLER:** SY **LOGGED:** SI **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.9m; NMLC-Coring to 8.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		gp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



Appendix C

Summary of Analytical Results



F07 LEES1 BUILDING

UNIVERSITY OF SYDNEY

UNEXPECTED FINDS PROPTOCOL

Contents

1.0	Objective	4
2.0	Framework.....	4
3.0	Notification.....	4
4.0	Management Strategy Actions.....	5
5.0	Monitoring and control.....	6
6.0	Classification.....	6
7.0	Reporting.....	6
8.0	Cleaning of Construction Routes	7
9.0	Appendices:	7

Unexpected Finds Protocol

1.0 Objective

This unexpected finds protocol has been prepared for bulk excavation and construction works to manage unexpected contamination / finds.

2.0 Framework

In the event that contaminated soils and/or groundwater within the project area are encountered during the demolition, excavation or construction works, we will immediately isolate the work area to minimise any risk of contamination exposure to workers and the environment, and give notice to the relevant CIS Representative.

Should unexpected hazardous material be encountered the processes and steps outlined below will apply:

- If at any time RCC discovers the presence on the Site of any material suspected of containing or likely to contain a substance defined or listed in the National Occupational Health and Safety Commission's ("NOHSC") Guidance Notes (NOHSC 1008:2004: "Approved Criteria for Classifying Hazardous Substances" and NOHSC 1005:1999:"List of Designated Hazardous Substances") it will not disturb the material under any circumstances. RCC will contact and inform Principal's Representative of the existence of the material on site and ensure that all persons are protected from exposure to the material until the nature of the material has been competently determined. The Principal's Representative will inspect the Site and issue directions to RCC in respect of further action to be taken.
- Hazardous Substance means a substance that is listed in the document entitled List of Designated Hazardous Substances published by Worksafe Australia; or a substance that fits the criteria for a hazardous substance set out in the document entitled Approved Criteria for Classifying Hazardous Substances published by Worksafe Australia.
- Asbestos, material containing asbestos, total recoverable hydrocarbons (TRH) and polycyclic aromatic hydrocarbons (PAH) contamination hotspots are recognised as hazardous substances subject to waste classification. Delineation of the extent of the PAH and TRH hotspot and determination if an RAP is warranted is required, noting material detected in BH6 are associated with the pavement material composition, and/or the presence of asphalt.
- Other substances in certain situations are also considered hazardous and therefore require controlled handling. Examples of these include glues, solvents, cleaning agents, paints, and water treatment chemicals.

3.0 Notification

With the initial notification or as soon as practicable thereafter, we will submit details, including:

- Type of substance.
- Location of the substance.
- Additional work and resources we estimate to be necessary to deal with the substance so that work and the subsequent use of the Works may proceed safely and without risk to health.

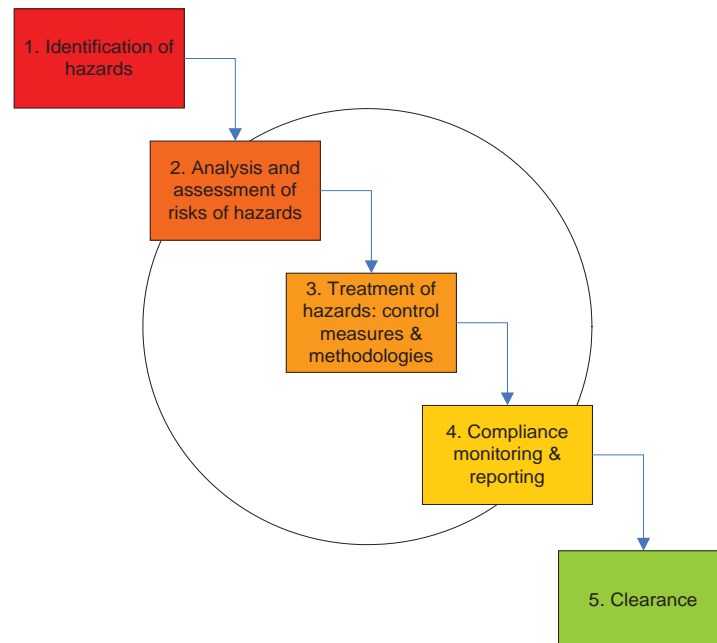
Unexpected Finds Protocol

- Other details reasonably required by the Principal's Representative.
- In planning and carrying out any work dealing with the substance we will take all reasonable steps:
- To carry out the work concurrently with other work wherever possible.
- To minimise the effects of the work on the Contractual Completion Dates.

4.0 Management Strategy Actions

The process that will be adopted to 'manage unexpected finds risks' involves:

- Identification of hazards: through further site investigation and sampling
- Analyse and assessment of risk of hazards
- Treatment of hazards: implement control measures and work methodologies to deal with the hazards (note: this may involve further analysis and reassessment where findings from original sampling depart from those conditions found during the undertaking of the works)
- Compliance monitoring and reporting: including clear communication and direction
- Clearance: allowing works to proceed.



During the course of the construction works, any soil material intended for disposal off site that has not been previously assessed shall initially be evaluated by a soil classification/geotechnical consultant, initially using visual and olfactory techniques to determine the potential for contamination.

Where contamination is suspected materials shall be sampled, tested and classified according to State Environmental Guidelines. Prior to any materials being removed from site all statutory requirements will be met and certification obtained.

Unexpected Finds Protocol

Disturbance of any contaminated soils identified will be minimised to reduce potential health and environmental concerns. Contaminated soils will be managed in accordance with State Environmental Guidelines. Contaminated soils are to be kept separate from stockpiles of other materials and be appropriately labelled (i.e. contaminated; imported clay; topsoil etc. and date of placement). Material tracking forms are to be developed and maintained.

To prevent cross contamination of underlying soils, hardstand areas or a low permeability liner is placed underneath the stockpile. Appropriate water diversion will be constructed around any contaminated soil stockpiles and they are covered to prevent contamination of surface water and runoff.

All soil/fill material requiring off-site disposal will be transported and disposed of at an appropriate location or waste facility in accordance with statutory regulations and guidelines. All vehicles in contact with contaminated materials are to be cleaned prior to leaving the site.

Soil materials (crushed rock sub-base, foundation and landscaping soil) imported to the Site to be used as clean fill will be required to be supported by appropriate certification.

Workers involved with the excavation or transportation of prescribed waste are to be informed of the risks posed by the material and appropriate handling methods.

5.0 Monitoring and control

Element	Control	Monitor
Assessment for contamination of excavated materials	Visual, olfactory and sampling	As required
Appropriate stockpiling of contaminated soil	Visual inspection	Weekly or as required
Validation of imported soil / fill	Certificate to be provided by supplier	Weekly
Classification of soil materials requiring off-site disposal (if required)	Sampling and analysis	Weekly or as required

6.0 Classification

Following the excavation of fill soils for the basement levels the underlying natural soil will be inspected and validated to determine if the underlying natural soil can be classified as virgin excavated natural material (VENM) or other suitable material.

7.0 Reporting

Copies of all relevant reports are retained on site and all relevant documentation associated with the classification and management of fill and soils is to be made available for review by CIS or their representative.

Unexpected Finds Protocol

Similarly, records and waste transport certificates relating to the disposal offsite of contaminated soil are retained.

8.0 Cleaning of Construction Routes

RCC will maintain the construction routes used by construction vehicles; adjacent to and within the site. RCC will ensure that roadways are cleaned regularly by our site personnel and/or sweeping subcontractor.

9.0 Appendices:

- 4.3 Environmental Controls (Unexpected Finds)
- 18.1 Record of Waste
- 25.08 Imported Fill Register

Environmental Actions and Monitoring Table

Environmental Aspect (to be read in conjunction with Appendix 4a, Environmental Risk Matrix)	Environmental Actions, Controls and Criteria	Operational Controls				Effectiveness of Controls			Checking, Corrective & Preventative Action		Resp.
		Induction and/or toolbox	RCC	Subcont. SWMS & contracts	Consult reports	Visual	Form 18.3 Environmental Inspection Checklist	Form 40.2 SWMS Compliance	Form 31.1 NCF/ Site Notice Refer PMP Section 4	Check records during audit	
1 Land (contaminated soils)	<ul style="list-style-type: none"> Stop work if unexpected potentially contaminated soils are encountered. Obtain waste classification from consultant in accordance with DECC guidelines Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes (June 2004) www.environment.nsw.gov.au/waste/envguidlins/index.htm 	✓		✓	✓	Daily	Weekly	As required	✓	SM/ SS	
	<ul style="list-style-type: none"> Where required a Remediation Action Plan will be developed by the Principal and implemented. Material to be disposed may require further testing (subject to RAP) and classified by consultants prior to disposal. Sign off by Site Auditor may be required to validate cleanup. 	✓	EP-002	✓	✓	Daily	Weekly	As required	✓	SM/ SS	

Environmental Actions and Monitoring Table

Environmental Aspect (to be read in conjunction with Appendix 4a, Environmental Risk Matrix)	Environmental Actions, Controls and Criteria	Operational Controls				Effectiveness of Controls			Checking, Corrective & Preventative Action		Resp.
		Induction and/or toolbox	RCC	Subcont. SWMS & contracts	Consult reports	Visual	Form 18.3 Environmental Inspection Checklist	Form 40.2 SWMS Compliance	Form 31.1 NCF/ Site Notice Refer PMP Section 4	Check records during audit	
7 Land	<ul style="list-style-type: none"> The requirements to import fill will be minimised by utilising on site cut material wherever possible. All analysis certificates shall be handed over as part of the completion documents to the client. Record all imported fill on Form 25.08 - Product Identification & Traceability. Survey if required. 										SM/ SS

The University of Sydney
22 Codrington Street
Darlington NSW 2008

Project 84897.04
28 April 2016
84897.04.R.001.Rev0
DW:jlb

Attention: Sam Gibson

Email: sam.gibson@sydney.edu.au

Dear Sirs

Regarding SEPP55 (Contamination)
LEES1 Carslaw Extension
Eastern Avenue, The University of Sydney

Item 12 (Contamination) of the *Secretary's Environment Assessment Requirements* for the Carslaw Building Extension (SSD 7054), 28 May 2015 states that it is to be demonstrated that the site is suitable for the proposed use in accordance with SEPP 55. Douglas Partners (DP) notes, however, that Department of Urban Affairs and Planning, Environment Protection Authority, *Managing Land Contamination, Planning Guidelines, SEPP55-Remediation of Land*, 1998, states that for the processing and determining a development application, the decision to be made will be to determine if the land is suitable, or **can or will** be made suitable for the proposed development. Furthermore, it is also noted under Section 4.3 of SEPP55 that for category 2 remediation (which would capture the current site) *then imposing conditions on the development consent for the use, requiring remediation to be carried out and validated either before other work commences or before occupation of the site* is an option open to the consent authority.

For the DP report, *Geotechnical Investigation, Proposed LEES1 Carslaw Extension, Eastern Avenue, The University of Sydney*, July 2015 (DP, 2015), the investigation included soil sampling from five test bores. Filling at one test bore was identified to have elevated concentrations of polycyclic aromatic hydrocarbons (PAH) and total recoverable hydrocarbons (TRH) and it was considered likely that the source of the PAH and TRH was the pavement material and/or the presence of asphalt. It was recommended that additional investigation be conducted in the vicinity of the test bore to define the extent and possible source of the contamination. It was considered that the site can be made suitable for the proposed development subject to the remediation (excavation and disposal) of this TRH and PAH impacted filling which could be undertaken as part of excavations for the proposed basement ('Level 01'). Some further *in situ* or *ex situ* testing has been recommended to confirm waste classification of soils to be disposed off-site.

Given that in DP (2015) it was stated that the site **can be made** suitable for the proposed development, we consider that the report satisfies the requirement of SEPP55. The remediation of the identified TRH and PAH contamination can be tied in with the excavations for the proposed development, and be conditioned in the development application approval, again complying with SEPP55. The methods for the recommended additional investigations, waste classification and remediation can be captured in a Remediation Action Plan (RAP), if necessary.



Integrated Practical Solutions

Brisbane • Cairns • Canberra • Central Coast • Coffs Harbour • Darwin • Geelong • Gold Coast • Macarthur
Melbourne • Newcastle • Perth • Port Macquarie • Sunshine Coast • Sydney • Townsville • Wollongong

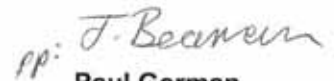
Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd



David Walker
Environmental Engineer

Reviewed by



Paul Gorman
Senior Associate