Douglas Partners
Geotechnics • Environment • Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
96 Hermitage Road
West Ryde NSW 2114
Australia

PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095
www.douglaspartners.com.au

RL:jlb
Project 44825
29 May 2007

Redfern-Waterloo Authority
Level 11, Tower 2
1 Lawson Square
REDFERN NSW 2016

Attention: Ms Joanne McGuinness

Dear Ms McGuinness

REVIEW OF PREVIOUS REPORTS
RACHEL FORSTER HOSPITAL
134-150 PITT STREET
REDFERN

This letter presents the results of a review of the preliminary contamination assessment reports previously undertaken at the site by Douglas Partners Pty Ltd (DP), to comment on the validity of the findings in the context of the current, revised development plan and to assess the suitability of the site for the proposed development. The review has been commissioned by the Redfern Waterloo Authority.

A Preliminary Contamination Assessment was undertaken by DP in November 2003. The assessment was commissioned by Atkinson Capital Insight Pty Ltd on behalf of Central Sydney Area Health Service (part of the Department of Health). The assessment was a limited intrusive sampling Preliminary Contamination Assessment with intrusive sampling undertaken over the accessible areas at the time of the investigation

A subsequent site inspection and a review of previous reports was undertaken by Douglas Partners at the site on 13 February 2007. The report confirmed that no discernible physical changes have occurred at the site since the previous assessment which was conducted in November 2003. Based on the available information, and noting that the land use category of the planned development has remained unchanged, DP considered that the original recommendations made in the Preliminary Contamination Assessment report were still valid.

It is understood from the client that the site has remained unchanged since DP's walkover inspection in February 2007. The detailed plan of the proposed development has, however, slightly altered. It is understood that the proposed redevelopment of the Rachel Forster Hospital site now includes a parcel of land in the central eastern portion of the site to be developed as Open Space. This land parcel is proposed to be dedicated to Council. The remaining portion of the site will be developed into residential unit blocks. In light of the above, an update of the previous contamination assessment has been requested by the client.

A site plan of the proposed redevelopment prepared by Lippmann Architects is attached as Drawing 1. It is understood that the proposed redevelopment of the site includes:

- The dedication of a land parcel to Council for use as Open Space (eastern portion of the site, along Pitt Street); and
- Four buildings (Building 1, Building 2, Building 3 and Building 4) comprising around 150 residential units. A two level basement carpark is proposed under Buildings 2 and 4. The bulk excavation for the construction of the basement carpark will be extended to a nominal depth of around 6 m below ground level.

In summary, the overall land use category of the proposed development area (i.e. the area of the proposed residential unit blocks) has remained unchanged since the 2003 assessment, i.e. residential with minimal soil access. The only substantial change is the area to be developed as open space, which should be assessed against the site assessment criteria for recreational open space.

In regard to the various portions of the current proposed development, the relevant site assessment criteria are:

- Landscaped open space: NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006).* Health based investigation Levels for Parks, recreational open space and playing fields (includes secondary schools) Open Space (HIL column 3) and Provisional Phytotoxicity-based Investigation Level (PPIL Column 5) for the top 500 mm of soil.
- Residential area: NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006).* Health based investigation Levels for Residential Development with minimal soil access (HIL column 2) and Provisional Phytotoxicity-based Investigation Level (PPIL Column 5) for the top 500 mm of soil in unsealed area.

The 2003 assessment conducted by DP comprised the drilling of 10 test bores (B1 to B10). In light of the current development plan, Bores 1, 2 and 3 were placed on the southern portion of the site (proposed concrete driveway adjacent to Building 1), Bores 6, 8 and 10 were placed on the eastern portion of the site (land parcel proposed to be dedicated to Council for use as Open Space) and Bores 4, 5, 7 and 9 were located in the western portion of the site (proposed Building 4 area which includes the construction of two basement levels of carpark). A site plan from the previous investigations is presented as an attachment.

A review of the bore logs indicated that the following conditions were encountered during the 2003 Assessment field work: A copy of the previous bore logs is provided as an attachment.

Material type	Southern Portion (Bores 1, 2 & 3)	Western Portion (Bores 4, 5, 7 & 9)	Eastern Portion (Bores 6, 8 & 10)
Filling	Crushed sandstone and brown sand filling with some crushed bricks and gravel to a maximum recorded depth of 0.7m	Clayey sand filling with some roadbase and sandstone gravel at Bores 4 and 7, with a trace of glass and gravel noted at Bore 7. Sandy clay filling with traces of ash and slag in Bore 9. Topsoil in Bore 5. The depth of filling reported ranged between 0.6 m in Bore 4 to 1.9 m in Bore 9.	Clay and sand filling with some gravel. The recorded depth of the filling ranged from 0.3m in Bore 6 to 1.5 m in Bore 8.
Natural	Natural sand and Clay	Sandy Clay underlain by clay which in turn was underlain by siltstone.	Sand, sandy clay, shaly clay and siltstone.

Selected soil/fill samples were analysed for the potential contaminants of concern. In view of the current available information, the previous laboratory results were assessed against the relevant land use criteria (based on the current development plan). The results are summarised in the following tables.

Table 1 – Previous Results of Laboratory Analysis for Contaminants in Soil Samples from the Proposed Open Space (mg/kg)

Test Bore/Depth	Heavy Metals								PAH		TPH		Benzene	Toluene	Ethyl-Benzene	Xylene	PCB[4]	OCP^	Phenols	Asbestos
	As	Cd	Cr[#]	Cu	Pb	Hg	Ni	Zn	B(a)P	Total PAH[4]	C_6-C_9	C_{10}-C_{36}								
B6/ 0.5	<3	<0.5	1	2	19	0.06	<0.2	15	**2.6**	28	<20	<120	<0.5	<0.5	<0.5	<1.5	<0.9	-	<0.5	Nil
Z5*	<3	<0.5	0.6	0.8	9	<0.05	<0.2	5	**-**	-	-	-	-	-	-	-	-	-	-	-
B8/ 0.5	<3	<0.5	8	3	29	0.10	2	71	1.8	22	<20	<120	<0.5	<0.5	<0.5	<1.5	-	<1.1	<0.5	Nil
B8/ 1.0	<3	<0.5	8	4	58	0.15	1	120	0.5	6.8	<20	<120	<0.5	<0.5	<0.5	<1.5	-	-	-	Nil
B8/ 1.5	<3	<0.5	2	2	13	<0.05	1	6	0.06	0.32	-	-	-	-	-	-	-	-	-	-
B10/ 0.5	<3	<0.5	7	9	340	0.20-	4	28	**3.9**	**54**	<20	<120	<0.5	<0.5	<0.5	<1.5	<0.9	<1.1	<0.5	Nil
B10/ 1.5	<3	<0.5	5	1	24	<0.05	0.5	3	0.06	0.33	<20	<120	<0.5	<0.5	<0.5	<1.5	-	-	<0.5	-
95% UCL	-	-	-	-	-	-	-	-	**3.8**	**49.2**	-	-	-	-	-	-	-	-	-	-
Site Assessment Criteria																				
HIL3	200	40	240000	2000	600	30	600	14000	2	40	65	1000	1	1.4	3.1	14	20	20/100/ 400/20[5]	17000	Nil
PPIL	20	3	400	100	600	1	60	200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Nil

Notes:for Table 1:
^ OCP given in order Aldrin+DIeldrin/ Chlordane/ DDD+DDE+DDT/ Heptachlor
ND Not Defined
- denotes not analysed
* denotes field replicate of sample B6/ 0.5
HIL3 – NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006). Health based investigation Levels for Parks, recreational open space and playing fields (includes secondary schools)*
PPIL - NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006). Provisional Phytotoxicity- Based Investigation Levels for sandy loams of pH 6-8.*
Bold indicates exceed dance of HIL3

Table 2 – Previous Results of Laboratory Analysis for Contaminants in Soil Samples from the Proposed Residential Area (mg/kg)

Test Bore/Depth	Heavy Metals								PAH		TPH		Benzene	Toluene	Ethyl-Benzene	Xylene	PCB[4]	OCP^	Phenols	Asbestos
	As	Cd	Cr[#]	Cu	Pb	Hg	Ni	Zn	B(a)P	Total PAH[4]	C_6-C_9	C_{10}-C_{36}								
B1/ 0.15-0.5	<3	<0.5	4	9	200	0.18	2	71	0.3	4.4	<20	<120	<0.5	<0.5	<0.5	<1.5	<0.9	<1.1	<0.5	-
B2/ 0.5	<3	<0.5	4	4	**750**	0.11	2	160	0.9	13	<20	<120	<0.5	<0.5	<0.5	<1.5	<0.9	<1.1	<0.5	Nil
B2/ 1.5	<3	<0.5	4	38	180	<0.05	3	170	3.3	**39**	<20	204	<0.5	<0.5	<0.5	<1.5		-	-	-
B3/ 0.2 -0.5	<3	<0.5	<0.5	1	10	<0.05	<0.2	3	0.3	6.6	<20	<120	<0.5	<0.5	<0.5	<1.5	-	-	-	Nil
Z3*	<3	<0.5	<0.5	0.7	5	<0.05	<0.2	2	-	-	-	-	-	-	-	-	-	-	-	-
B4/ 0.18-0.5	<3	<0.5	6	10	30	0.07	7	44	0.3	4.0	<20	<120	<0.5	<0.5	<0.5	<1.5	-	<1.1	<0.5	Nil
B5/ 0-0.5	11	<0.5	19	29	44	0.14	30	59	<0.05	0.0	<20	<120	0.53	<0.5	<0.5	<1.5	<0.9	<1.1	<0.5	Nil
B7/ 0.2-0.5	<3	<0.5	8	14	140	0.95	2	49	0.2	2.2	<20	<120	<0.5	<0.5	<0.5	<1.5	-	<1.1	<0.5	Nil
B7/1.5	<3	<0.5	13	4	36	0.18	4	16	0.1	1.1	-	-	-	-	-	-	-	-	-	-
B9/ 0.5	<3	<0.5	8	38	150	0.62	3	190	**4.5**	**53**	<20	<120	<0.5	<0.5	<0.5	<1.5	<0.9	<1.1	<0.5	Nil
B9/1.5	<3	<0.5	10	32	190	0.62	4	**230**	**7.4**	**85**	<20	<120	<0.5	<0.5	<0.5	<1.5	-	<1.1	-	Nil
B9/ 2.5	6	<0.5	12	22	58	0.16	1	0.5	0.6	7.2	<20	<120	<0.5	<0.5	<0.5	<1.5	-	-	-	-
95% UCL	-	-	-	-	-	-	-	-	**4.45**	**51.9**	-	-	-	-	-	-	-	-	-	-
Site Assessment Criteria																				
HIL1	100	20	120000	1000	300	15	600	7000	1	20	65	1000	1	1.4	3.1	14	10	10/50/ 200/10	8500	Nil
HIL2	400	80	480000	4000	1200	60	2400	28000	4	80	65	1000	1	1.4	3.1	14	20	20/100/ 400/20[5]	34000	Nil
PPIL	20	3	400	100	600	1	60	200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Nil

Notes for Table 2:

^ OCP given in order Aldrin+DIeldrin/ Chlordane/ DDD+DDE+DDT/ Heptachlor

ND Not Defined

- denotes not analysed

* denotes field replicate of sample B3/ 0.2-0.5

HIL2 – NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006). Health based investigation Levels for residential sites with minimal access to soil including high rise apartments.*

PPIL - NSW EPA Contaminated Site: *Guidelines for the NSW Site Auditor Scheme (2006). Provisional Phytotoxicity- Based Investigation Levels for sandy loams of pH 6-8.*

Bold indicates exceed dance of PPIL

Bold indicates exceedance of HIL1 & PPIL

Bold indicates exceedance of HIL1 & HIL2

Bold indicates exceedance of HIL1

The soil/fill analytical results from the 2003 Assessment assessed against the relevant site assessment criteria indicates that:

Proposed open space area:

- The recorded concentrations of heavy metals, TPH, BTEX, PCB, OCB, Phenols in all samples analysed were within the site assessment criteria for open space (i.e. both HIL Column 3 and PPIL Column 5).

- The PAH and B(a)P concentration of samples within the proposed open space area were generally within the site assessment criteria with the exception of two near surface filling samples. Sample B6/0.5 recorded a B(a)P concentration of 2.6 mg/kg, marginally above the SAC of 2 mg/kg and Sample 10/0.5 recorded a B(a)P and PAH concentration of 3.9 mg/kg and 54 mg/kg respectively above their corresponding SAC for Open Spaces (2 mg/kg and 40 mg/kg respectively).

- Analytical results of the deeper sample from Borehole 10 i.e., 10/1.5 recorded a B(a)P and PAH concentration of 0.06 mg/kg and 0.33 mg/kg respectively, both of which were well within the SAC. The results suggest that the B(a)P and PAH exceedance are confined to the near surface filling material.

- Asbestos was not detected in the soil samples analysed for asbestos.

Proposed residential building area

- The recorded concentrations of TPH, BTEX, PCB, OCB, Phenols in all samples analysed were within the site assessment criteria for residential sites with minimal access to soils (HIL Column 2 and PPIL Column 5).

- The heavy metal concentrations of soil/fill samples collected from the residential area were all within the health-based site assessment criteria for residential sites with gardens and minimal access to soils (HIL Column 2). The majority of the samples were also within the PPILs with the exception of two samples for lead and zinc. Sample B2/0.5 recorded exceedance of lead (750 mg/kg) above the PPIL of 600 mg/kg. Sample B9/1.5 recorded a marginal exceedance of zinc (230 mg/kg) above the PPILs (200 mg/kg) but was within HIL Column 2.

- The lead and zinc concentrations from the deeper samples from Test Bores 2 (B2/1.5) and 9 (B9/2.5) recorded lead (180 mg/kg) and zinc (0.5 mg/kg) concentrations within the SAC, suggesting that the lead and zinc exceedances are confined to the filling material.

- The recorded PAH and B(a)P concentrations in most of the samples in the proposed residential area were within the SAC criteria for residential sites with minimal soil access with the exception of benzo(a)pyrene in two samples collected from the filling in Bore 9. Samples 9/0.5 and 9/1.5 recorded B(a)P concentrations of 4.5 mg/kg and 7.4 mg/kg respectively, both of which exceeded the SAC of 4 mg/kg. The deeper sample collected from Bore 9 in the underlying shaly clay (at 2.5 m depth) registered a low B(a)P concentration of 0.6 mg/kg. The analytical results suggest that the detected contamination is limited to the filling material in the vicinity of location 9.

On the basis of the previous assessment results and the current development plans, the following conclusions and recommendations are made:

- The land parcel proposed to be dedicated to Council can be rendered suitable for the proposed open space area subject to the removal of the top soil (nominally to 0.5 m bgl) material. Given the fact that the proposed open space is currently a bitumen paved carpark, it is envisaged that appropriate earthworks involving removal of the bitumen pavement and surficial filling will be required. In this regard, the detected contaminants in the vicinity of Bores 6 and 10 can be removed at the time of site development.

- In this regard, the site can be rendered suitable for the proposed construction of residential land use subject to the removal of the contaminated surficial filling material in the open space area. The process is envisaged to be simple and straightforward, and the extent of excavation can be determined via step out validation analysis.

- As the proposed development involves the construction of residential / apartments with 2 levels of basement car park at the western portion of the site, bulk excavation to depths in excess of 6 m and off-site disposal of spoil would be required.

  In other words, contaminated soil present in the vicinity of Bore 9 will be removed as part of the site bulk excavation process. The current development plans also indicate that soil material in the vicinity of Bore 2 is to be permanently concrete paved and is to be used as driveway. In this regard, it is considered that the site can be made suitable for the proposed development.

In summary, the site can be rendered suitable for the proposed development with open space and residential / apartments.

Should you have further queries, please do not hesitate to contact either of the undersigned at 9809 0666.

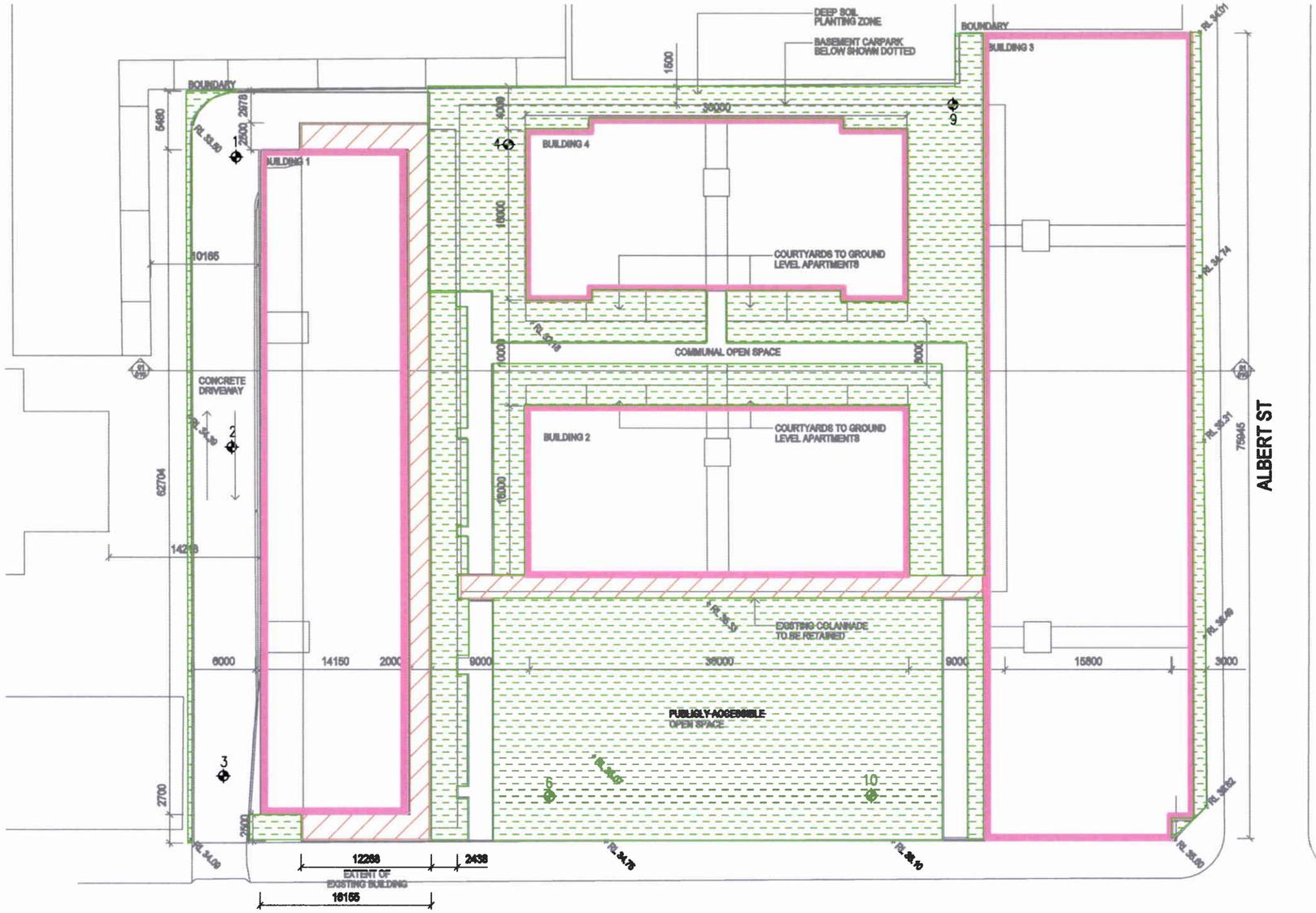
Yours faithfully
DOUGLAS PARTNERS PTY LTD

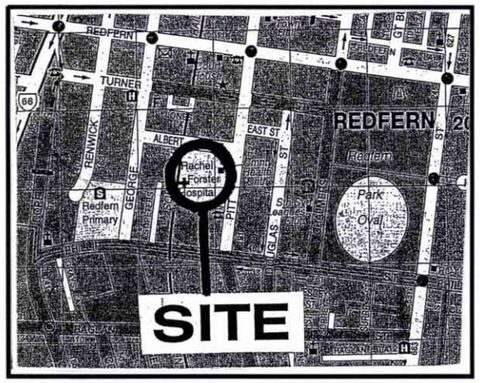
Reviewed by

Romila Lobo
Environmental Scientist

Ronnie Tong
Principal

Attachments: Drawings 1 and 1A
Test Bore Reports and Notes Relating to this Report





LOCALITY PLAN

LEGEND

- PREVIOUS TEST BORE LOCATION
- EXISTING BUILDING
- PROPOSED BUILDING
- LANDSCAPE & OPEN SPACE

SCALE 1:500

0 10 20 30 40 50m

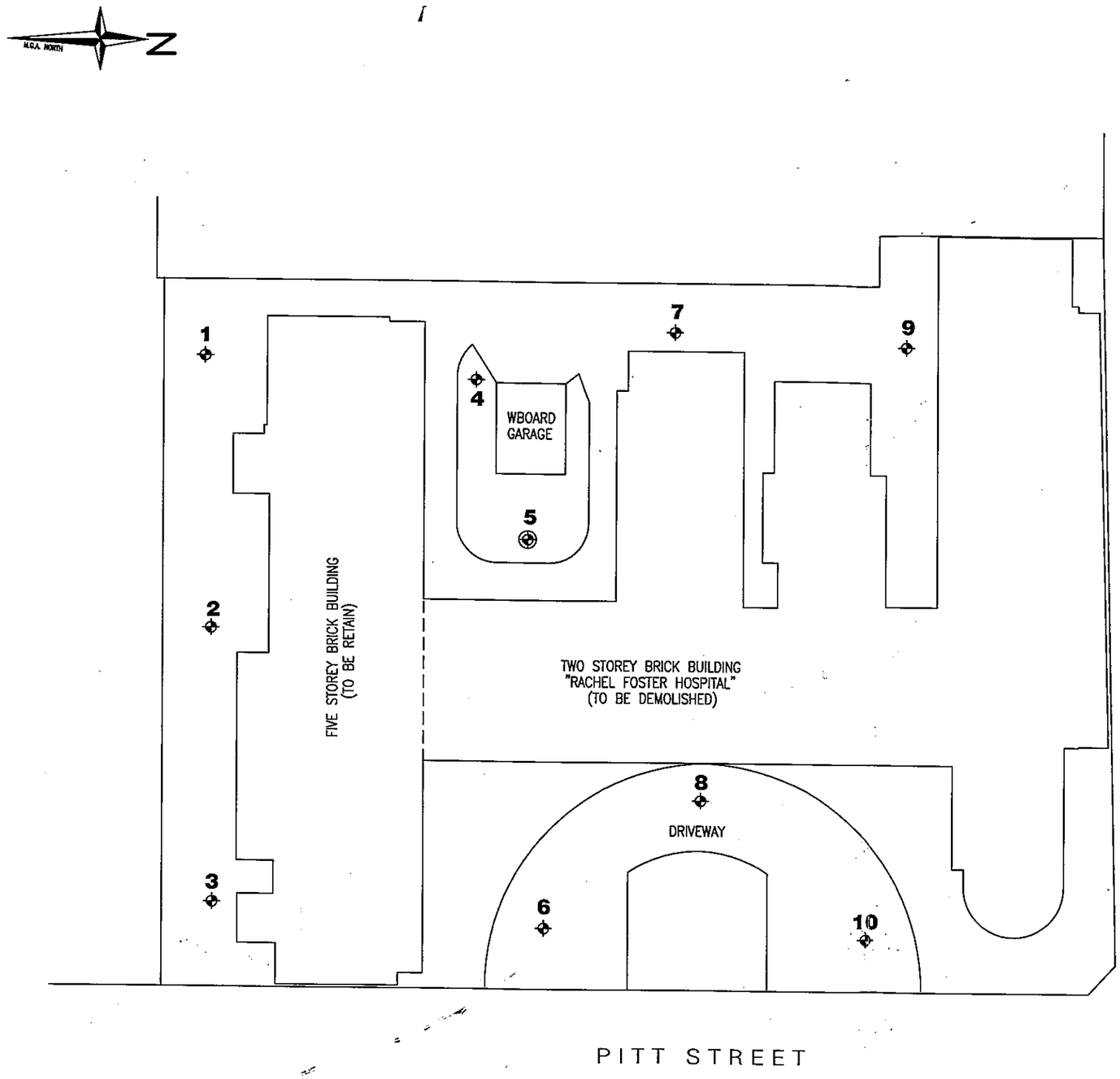
Douglas Partners
Geotechnics, Environment, Groundwater

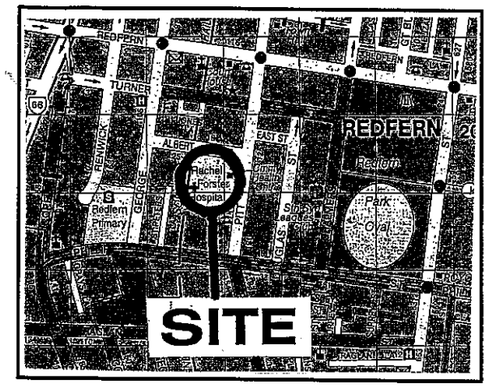
Sydney, Newcastle, Brisbane, Melbourne, Wyong, Canberra, Campbelltown, Townsville, Perth, Cairns, Wollongong, Darwin, Gold Coast, Sunshine Coast

TITLE: **Proposed Development & Location of Previous Bores**
Preliminary Contamination Assessment
Rachel Forster Hospital
REDFERN

CLIENT: Ecoplan Projects			
DRAWN BY: PSCH	SCALE: As shown	PROJECT No: 44825	OFFICE: SYDNEY
APPROVED BY:		DATE: 28.5.2007	DRAWING No: 1

P:\44825 REDFERN, Contamination Assessment RT\Drawings\44825-1.dwg, 5/29/2007 11:56:55 AM





LOCALITY PLAN

Douglas Partners
Geotechnics, Environment, Groundwater

Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyong, Campbelltown, Townsville Cairns, Wollongong

TITLE: Location of Test Bores
Rachel Forster Hospital
134-150 Pitt Street
REDFERN

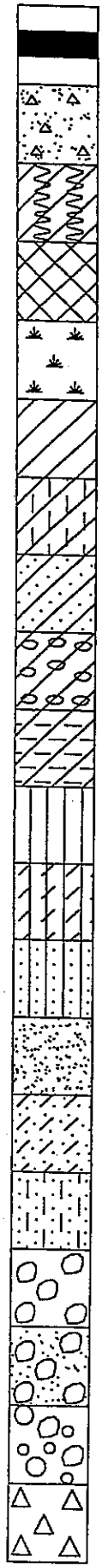
CLIENT: Central Sydney Area Health Service

DRAWN BY: PSCH	SCALE: As shown	PROJECT No: 36299A	OFFICE: SYDNEY
APPROVED BY: PF		DATE: 29.10.2003	DRAWING No: 1A

C:\DRAWINGS2003\OTOBER2003\36299A.dwg, 29/10/2003 02:20:35 PM

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

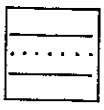
GRAVEL

SANDY GRAVEL

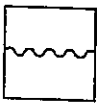
COBBLES/BOULDERS

TALUS

SEAMS

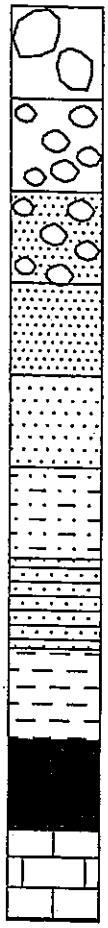


SEAM >10mm



SEAM <10mm

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

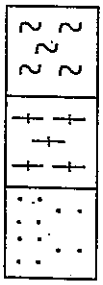
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

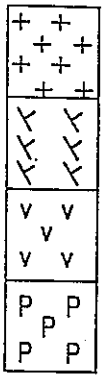


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

Douglas Partners

Geotechnics, Environment, Groundwater

TEST BORE REPORT

BORE No: 1

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 25 Sep 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 28.1 AHD SHEET 1 OF 1

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Results	Headspace PID (ppm)
0.15	CONCRETE	A	0.17		
0.3	FILLING - crushed sandstone filling				
	SILTY SAND - very loose, brown fine grained silty sand	A/E	0.5		1
		A/E*	1.0		1
		S		2,2,2 N=4	
		E	1.45 1.5		1
1.8	SAND - loose, yellow brown fine grained sand with some brown, slightly cemented bands (coffee rock)	E	2.5		1
		S		2,4,5 N=9	
			2.95		
		E	4.0		2
5.0	CLAY - hard, light grey mottled yellow and orange brown clay				
		S	5.5	5,11,25 N = 36	
5.95	TEST BORE DISCONTINUED AT 5.95m		5.95		

RIG: SCOUT DRILLER: WARD LOGGED: JARDINE CASING: UNCASED

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 5.5m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: A* INDICATES FIELD REPLICATE SAMPLE Z1 TAKEN. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	PID	Photo Ionisation Detector

CHECKED
Initials: KJB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 2
DATE: 25 Sep 03
SHEET 1 OF 1

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES
PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL
SURFACE LEVEL: 28.9 AHD
LOCATION: 134-150 PITT ST, REDFERN
DIP OF HOLE: 90°
AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Results	Headspace PID (ppm)
0.15	CONCRETE	A	0.2		
	FILLING - brown sand filling with bricks and gravel	A/E	0.5		1
0.7	SAND - very loose, light brown/grey fine grained sand	A	1.0		
		S		1,2,1 N=3	
		E	1.45 1.5		1
	Below 2.5m: medium dense	E	2.5		1
		S	2.95	4,8,5 N=13	
		E	4.0		1
4.1	CLAY - very stiff, light red brown and grey clay with a trace of sand	S	4.45	6,9,9 N=18	
5.3	TEST BORE DISCONTINUED AT 5.3m	A	5.3		1

RIG: SCOUT
DRILLER: WARD
LOGGED: JARDINE
CASING: UNCASED

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 5.3m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: MOVED 30cm TO LEFT DUE TO PRESENCE OF METAL PIPE. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	PID	Photo Ionisation Detector

CHECKED
Initials: WJB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 3
DATE: 25 Sep 03
SHEET 1 OF 1

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES
PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL
SURFACE LEVEL: 29.0 AHD
LOCATION: 134-150 PITT ST, REDFERN
DIP OF HOLE: 90°
AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Results	Headspace PID (ppm)
0.15	CONCRETE	A	0.2		
0.3	FILLING - brown sand filling with brick and sandstone gravel	A/E*	0.5		4
	SAND - loose, grey brown fine grained sand	A	1.0		
		S		1,3,4 N=7	
		E	1.45 1.5		4
	Below 2.5m: medium dense, yellow brown	E	2.5		3
		S		3,9,6 N=15	
			2.95		
3.1	CLAY - hard, light red brown and grey clay				
		E	4.0		2
		S		10,17,25/130mm refusal	
4.3	TEST BORE DISCONTINUED AT 4.3m		4.3		

RIG: SCOUT
DRILLER: WARD
LOGGED: JARDINE
CASING: UNCASED

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 4.3m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: A* INDICATES FIELD REPLICATE SAMPLE Z3 TAKEN. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	PID	Photo Ionisation Detector

CHECKED
Initials: KSB
Date: 30/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 4

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 29 Sep 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 27.4 AHD SHEET 1 OF 1

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
0.18	CONCRETE	A	0.2		
	FILLING - dark grey coarse grained sand filling, clayey with some roadbase and sandstone gravel	A	0.4		
0.6		E	0.5	PID=3ppm	
	SAND - loose, grey fine grained sand	A	0.9		
1			1.0		
		S		1,4,6 N = 10	
1.4	SAND - yellow brown and dark brown sand, slightly cemented (coffee rock)	E	1.45 1.5	PID=1ppm	
1.8	SANDY CLAY - stiff, yellow brown sandy clay				
2		E	2.4	PID=1ppm	
		S	2.5	2,4,5 N = 9	
2.9	CLAY - light grey and red brown clay with ironstone		2.95		
3					
4		E	3.9	PID=3ppm	
4.0	SHALY CLAY - hard, light grey shaly clay with ironstone bands	S	4.0	10,17,25/120mm refusal	
4.42	TEST BORE DISCONTINUED AT 4.42m		4.42		
5					
6					
7					
8					
9					

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: UNCASED

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 4.4m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED Initials: KSB Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 5

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 26-29 SEPT 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 26.7 AHD SHEET 1 OF 1

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ext Low, Very Low, Low, Medium, High, Very High, Ext High)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.3	TOPSOIL - brown peaty silty clay topsoil with some roots						B			
	CLAY - hard, light red brown and grey clay with a trace of sand						A			
							A/E			PID=2ppm
1							A			
							U_{50}			pp=>500kPa
							E			PID=1ppm
2										
							E			PID=2ppm
							S			9,17,12/140mm refusal
3 3.0	SILTSTONE - extremely low, very low and low strength, highly weathered, highly fractured, orange brown and light and dark grey siltstone				rock is fractured along bedding planes dipping 0°- 10° & Joints dipping 35°- 45°		C	100	0	
3.98	SILTSTONE - very low, low and low to medium strength, highly weathered, highly fractured and fragmented, orange brown grey and dark grey/black siltstone. Some extremely low strength bands						C	100	0	
5					5.48-5.60m: numerous 5mm to 10mm clay bands					
6										
6.27	SILTSTONE - medium strength, fresh, slightly fractured, dark grey/black siltstone						C	100	56	PL(A) = 0.9MPa
7	6.47-6.55m: highly weathered, fragmented band									PL(A) = 0.3MPa
					7.43m: J35°smooth planar					
8 8.0	TEST BORE DISCONTINUED AT 8.0m				7.56-7.77m: rock fragmented & fractured along irregular planar joints dipping 90°					
9										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 3.5m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 3.0m; NMLC-CORING TO 8.0m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED Initials: KJB Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 6
DATE: 02 Oct 03
SHEET 1 OF 1

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 29.5 AHD
LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: –

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.04	BITUMEN						A			
0.14	CONCRETE						A			
0.3	FILLING - grey sand and orange brown clay filling with some gravel						E*			
0.9	SAND - light grey/yellow brown fine grained sand with a trace of silt						A			
1	SAND - loose, orange brown fine grained sand, slightly cemented						S			2,3,3 N = 6
1.6	CLAY - very stiff, light grey and red brown clay with ironstone						E			
2							E			
							S			4,9,10 N = 19
3							E			pp = 300kPa
3.3	SHALY CLAY - light grey and red brown shaly clay with ironstone									
4.1	SHALY CLAY - very stiff, light grey mottled yellow and red brown shaly clay (extremely weathered siltstone)				4.1m: CORE LOSS: 200mm		C	88	0	pp = 280kPa
4.3										pp = 200kPa
5										pp = 300kPa
5.7	SHALY CLAY - hard, light grey and red brown shaly clay with ironstone bands and nodules (extremely weathered siltstone)									pp>400kPa
6							C	100	0	
6.45	SILTSTONE - very low and low to medium strength, highly and moderately weathered, highly fractured, light and dark grey siltstone with some sandstone laminae				rock is fractured along J dipping 30°- 55° & 75°- 80° & numerous bedding planes dipping 0°- 5°					
7										
7.24	SILTSTONE - low to medium strength, moderately weathered, slightly fractured then fractured, dark grey and orange brown siltstone with 10% sandstone laminae						C	100	35	PL(A) = 0.3MPa
8										
8.7	TEST BORE DISCONTINUED AT 8.7m									
9										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 4.1m

TYPE OF BORING: DIATUBE TO 0.14m; SPIRAL FLIGHT AUGER TO 4.1m; NMLC-CORING TO 8.7m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E* INDICATES FIELD REPLICATE SAMPLE Z5 TAKEN. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: KJB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 7

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 29 Sep 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 27.4 AHD SHEET 1 OF 2

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: –

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.15	CONCRETE									
	FILLING - dark brown black clayey sand filling, slightly peaty with a trace of glass and gravel						A			
0.7	SAND - loose, grey brown fine grained sand with some silt						A E* A			PID=1ppm
1							S			2,4,5 N = 9
1.4	SANDY CLAY - grey and yellow brown mottled sandy clay, slightly cemented						E			PID=3ppm
2										
2.4	CLAY - stiff, light grey and red and yellow brown mottled clay with ironstone						E			PID=2ppm
3							S			2,4,7 N = 11
4							E			PID=2ppm
4.0	SHALY CLAY - hard, red brown and light grey shaly clay with ironstone bands						S			10,17,25/140mm refusal
4.5	SILTSTONE - extremely low strength, extremely weathered, light grey and orange and yellow brown siltstone. Numerous 5-10mm medium strength ironstone bands Below 5.10m: highly weathered				4.5-9.6m: rock is fractured along numerous bedding planes dipping 0°- 20° & Joints dipping 45°- 90°		C	100	0	
5										
5.67	SILTSTONE - very low, low and low to medium strength, highly weathered, fragmented and fractured, orange brown and dark grey siltstone						C	100	0	
6										
7							C	100	0	
8							C	100	0	
9							C	100	58	
9.9	9.6 to 9.75m: medium strength band				9.55m: J80° smooth planar, limonite stained 9.7m: J60° rough planar					

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 5.0m

TYPE OF BORING: SPIRAL FIGHT AUGER TO 4.5m; NMLC-CORING TO 11.55m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E* INDICATES FIELD REPLICATE SAMPLE Z4 TAKEN. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED Initials: WJB Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 7
DATE: 29 Sep 03
SHEET 2 OF 2
AZIMUTH: –

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 27.4 AHD
LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90°

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
11	SILTSTONE - medium strength, fresh, fractured and slightly fractured, dark grey siltstone with 5% sandstone laminae *(continued)*				9.81m: J75° rough planar, limonite stained 9.92m: J45° smooth planar, limonite stained 10.36m: J45°smooth planar 10.58m: J35°smooth planar 10.69m: J40°smooth planar 10.73m: B0° 5mm clay		C	100	58	PL(A) = 0.5MPa PL(A) = 0.7MPa
11.55	TEST BORE DISCONTINUED AT 11.55m									
12										
13										
14										
15										
16										
17										
18										
19										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 5.0m

TYPE OF BORING: SPIRAL FIGHT AUGER TO 4.5m; NMLC-CORING TO 11.55m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E* INDICATES FIELD REPLICATE SAMPLE Z4 TAKEN. E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: KSB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 8

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 01 Oct 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 29.9 AHD SHEET 1 OF 2

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.04	BITUMEN									
0.15	CONCRETE									
0.25	FILLING - brown sand filling with roots and sandstone gravel						A			
0.6	FILLING - orange brown clayey sand filling						A			PID=2ppm
1	FILLING - light orange brown sand and clay nodule filling with brick and sandstone gravel						E			
1.5	Below 1.0m: grey sand and crushed sandstone						A			
1.8	SAND - brown sand (driller's description)						E			3,3,6 N=9
2.0	SANDY CLAY - grey and brown sandy clay (driller's description)						S			
2	CLAY - hard, light grey and red brown clay						E			PID=2ppm
2.85	CLAY - light grey and red brown clay with ironstone gravel						E			PID=10ppm
3							U_{50}			pp=380->500kPa
3.5	SHALY CLAY - very stiff, light grey shaly clay with a trace of decomposed roots (extremely weathered siltstone)						E			PID=2ppm
4							S			2,6,14 N = 20
	Below 4.5m: hard						C	100	0	pp = 280kPa pp = 500kPa
5										
	Below 5.4m: some medium strength red brown ironstone bands and nodules									
6										
6.3	SILTSTONE - very low and low strength, highly then extremely weathered, light grey, grey and orange brown siltstone . Some extremely low strength bands				6.3m: rock is fractured along bedding planes dipping 0°- 5° & joints dipping 45°- 90° 6.6-6.76m: brecciated zone		C	100	0	
7										
7.33	SILTSTONE - extremely low and low to medium strength, extremely and highly weathered, light grey and orange brown siltstone									
7.7	SILTSTONE - very low and low to medium strength, extremely and highly weathered, light grey, dark grey and orange brown siltstone. Occasional extremely low and low strength bands				8.0-8.3m: fragmented, discontinuities obscured 8.3-8.69m: brecciated zone		C	100	0	
8										
9										
9.18	SILTSTONE - low to medium strength, slightly weathered, dark grey/black and orange brown siltstone						C	100	38	
9.6										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 4.45m

TYPE OF BORING: DIATUBE TO 0.15m; SPIRAL FLIGHT AUGER TO 4.45m; NMLC-CORING TO 10.20m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED Initials: GSB Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 8

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A DATE: 01 Oct 03

PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 29.9 AHD SHEET 2 OF 2

LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
10.2	SILTSTONE - medium strength, fresh, fractured and slightly fractured, dark grey/black siltstone *(continued)*				10.1m: J75° irregular, planar, limonite stained		C	100	38	
	TEST BORE DISCONTINUED AT 10.2m									
11										
12										
13										
14										
15										
16										
17										
18										
19										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 4.45m

TYPE OF BORING: DIATUBE TO 0.15m; SPIRAL FLIGHT AUGER TO 4.45m; NMLC-CORING TO 10.20m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED Initials: KJB Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 9
DATE: 03 Oct 03
SHEET 1 OF 1
AZIMUTH: --

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 27.5 AHD
LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90°

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)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.18	CONCRETE									
	FILLING - dark grey and yellow brown sandy clay filling with sandstone gravel and a trace of slag and ash						A A E A			PID=2ppm
1							S			1,1,0 N = 1
							E			PID=1ppm
1.9	SANDY CLAY - grey and brown sandy clay (driller's description)									
2.3	SHALY CLAY - hard, light grey and red brown shaly clay with ironstone and a trace of thin roots (extremely weathered siltstone)						E			PID=1ppm
3							S			6,13,19 N = 32
3.5	SILTSTONE - extremely low and very low strength, extremely weathered, light grey and orange brown siltstone				Rock is fractured along Joints dipping 35°- 45° & 75°- 85° and numerous bedding planes dipping 0°- 10°		C	100	0	
4.65	SILTSTONE - low and low to medium strength, highly to moderately weathered, highly fractured, orange brown and dark grey siltstone with 15% - 20% sandstone laminae. Some extremely low and very low strength bands. Numerous 1-2mm light grey clay seams						C	100	0	
5.68	SILTSTONE - low to medium strength, moderately and highly weathered, highly fractured, dark grey and orange brown siltstone with 15% to 20% sandstone laminae 6.40-6.90m: very low and low strength, brecciated shear zone				6.4-6.9m: brecciated/shear zone		C	100	0	
7.45	SILTSTONE - low to medium strength, slightly weathered, fractured, dark grey/black siltstone with 10% sandstone laminae									PL(A) = 0.3MPa
7.95	TEST BORE DISCONTINUED AT 7.95m									
8										
9										

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 2.7m

TYPE OF BORING: DIATUBE TO 0.18m; SPIRAL FLIGHT AUGER TO 2.7m; NMLC-CORING TO 7.95m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: KSB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 10
DATE: 02 Oct 03
SHEET 1 OF 1

CLIENT: CENTRAL SYDNEY AREA HEALTH SERVICES PROJECT No: 36299/36299A
PROJECT: RACHEL FORSTER HOSPITAL SURFACE LEVEL: 29.9 AHD
LOCATION: 134-150 PITT ST, REDFERN DIP OF HOLE: 90° AZIMUTH: --

Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FR FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.05	BITUMEN						A			
0.15	CONCRETE						B			
0.4	FILLING - grey coarse grained sand filling with sandstone, brick and coal gravel						A			PID=2ppm
0.7	SAND - brown fine grained sand, slightly peaty with a trace of roots						E			
1	SAND - loose, orange brown fine grained sand. Slightly cemented in places						A			
1.4	SANDY CLAY - grey and brown sandy clay (driller's description)						S			1,2,2 N = 4
1.9	CLAY - stiff, red and yellow brown mottled clay						E			PID=1ppm
3.0	SHALY CLAY - hard, light grey shaly clay with ironstone bands (extremely weathered siltstone)						E			PID=1ppm
							S			2,3,7 N = 10
							E			
							C	100	0	pp>400kPa pp>400kPa pp>400kPa
6.7	SILTSTONE - extremely low, very low and low strength, extremely and highly weathered, light grey, grey, red and orange brown siltstone with some sandstone laminae. Numerous low to medium strength, thin ironstone bands				Rock is fractured along numerous bedding planes dipping 0° - 10°		C	100	0	
							C	100	0	
8.95	TEST BORE DISCONTINUED AT 8.95m									

RIG: SCOUT DRILLER: J WARD LOGGED: JARDINE CASING: TO 4.1m

TYPE OF BORING: DIATUBE TO 0.15m; SPIRAL FLIGHT AUGER TO 4.1m; NMLC-CORING TO 8.95m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: E = ENVIRONMENTAL SAMPLE

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: KAB
Date: 29/10/03

Douglas Partners
Geotechnics · Environment · Groundwater

Douglas Partners
Geotechnics · Environment · Groundwater

NOTES RELATING TO THIS REPORT

Introduction

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

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

Description and Classification Methods

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

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

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

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

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

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

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

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

Sampling

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

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

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

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

Drilling Methods.

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

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

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

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

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water

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

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

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

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  as 4, 6, 7
  N = 13

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

  as 15, 30/40 mm.

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

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

Cone Penetrometer Testing and Interpretation

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

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

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

The information provided on the plotted results comprises: —

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

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

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

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

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

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

q_c = (12 to 18) c_u

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

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

Hand Penetrometers

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

Two relatively similar tests are used.

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

Laboratory Testing

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

Bore Logs

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

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

Ground Water

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

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

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

Engineering Reports

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

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

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

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

Site Anomalies

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

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

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