Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

REPORT
on
GEOLOGICAL AND GROUNDWATER ASSESSMENT

REGIONAL DISTRIBUTION CENTRE
READYMIX SITE
KELLOGG ROAD, ROOTY HILL

Prepared for
NECS

Project 37916
June 2005

Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
on
GEOLOGICAL AND GROUNDWATER ASSESSMENT

REGIONAL DISTRIBUTION CENTRE
READYMIX SITE
KELLOGG ROAD, ROOTY HILL

Prepared for
NECS

Project 37916
June 2005

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
sydney@douglaspartners.com.au

TABLE OF CONTENTS

Page

MJT/FM:jlb
Project 37916
2 June 2005

REPORT ON GEOLOGICAL AND GROUNDWATER ASSESSMENT

REGIONAL DISTRIBUTION CENTRE

READYMIX SITE, KELLOGG ROAD, ROOTY HILL

1. INTRODUCTION

This report presents the results of a geological and groundwater assessment undertaken on Lot 1, DP582388 and Lot 5, DP255515, Kellogg Road, Rooty Hill. The work was carried out at the request of NECS, on behalf of Readymix.

It is understood that the construction of a Regional Distribution Centre including a concrete batching plant and associated infrastructure is planned for the site. The geological assessment was required to provide information on the soils, rocks and groundwater for an Environmental Impact Study which is being prepared for the site.

The assessment comprised the review of available information, including previous investigations, drilling of four deep test bores on the main area of the site, together with measurement and sampling of groundwater. In addition five shallow bores were drilled on the small portion of the site between Kellogg Road and Woodstock Road to obtain samples for laboratory testing. Details are given in the report, together with comments on the findings of the investigation.

2. SITE DESCRIPTION AND PREVIOUS INVESTIGATIONS

The site comprises an irregular shaped area located to the north and east of Kellogg Road, Rooty Hill. It is bounded to the north by Woodstock Avenue, the Nurragingy Reserve and Eastern Creek to the east, a local access road (North Parade) and the main western railway line to the south, and Onesteel's Mini Mill to the west.

The site is situated in gently undulating terrain sloping towards a small creek or drainage channel which passes across the southern half of the site, flowing in a north-easterly direction towards Eastern Creek. The natural surface levels fall from a high point on Woodstock Road (Lot 1), to a low point in the drainage channel midway along the eastern boundary of Lot 5.

At the time of the geotechnical investigation in 2003, the site was clear of structures and mostly covered by grass with some relatively dense vegetation along the drainage channel. On the central portion of the site there were some large mounds of filling, typically 3-4 m high. It is understood that this filling came from excavations undertaken on the adjacent Onesteel site.

Two previous investigations have been undertaken on the site. In February 2000, Coffey Geosciences Pty Ltd (CG) carried out a site appraisal of Lot 5 to assess the geotechnical aspects of the site for industrial redevelopment. In the report (Ref No. S20339/1-AD, dated 28 February 2000) CG presented the results of 15 test pits excavated across the site and laboratory testing of soils, and gave general recommendations for site classification and design of footings and pavements.

In February 2000, CH2MHill undertook a Phase 1 Environmental Assessment of Lot 5 (Ref No. 110127). This assessment comprised an inspection of the site, a review of the site history and a review of the site geology and groundwater.

3. REGIONAL GEOLOGY AND SOILS

The site is mapped on the Penrith 1:100 000 Geological Series Sheet as being underlain by Bringelly Shale (Rwb) of Triassic Age, however the map indicates that there are also some alluvial deposits (Qal) along Eastern Creek and its tributaries. The alluvial soils have been deposited on top of the Bringelly Shale and the geological map indicates the alluvial soils are probably present beneath the southern section of the site. An extract from the regional geological map is given on Drawing 1 in Appendix A.

Bringelly Shale typically comprises beds of dark grey to black siltstone, claystone, finely interlaminated siltstone and sandstone (laminite), shale and fine grained sandstone. These rocks, particularly the claystones, usually weather to form moderately to highly reactive clay soils.

The alluvial soils have been deposited in a fluvial environment and include clays, silts and fine grained sands.

The only structural feature shown on the geological map in the area is the Penrith Basin Syncline. This feature indicates that the site is located close to the centre of the Penrith Basin within a very gentle fold in the sedimentary rocks.

The Penrith 1:100,000 Soils Landscapes Series map prepared by the Soil Conservation Service of NSW indicates that the northern half of the site is underlain by soils of the Blacktown landscape group (bt), while the southern half of the site is underlain by soils of the South Creek landscape group (sc). An extract of the soils landscapes map is given on Drawing 2 in Appendix A.

The Blacktown soil landscape group usually occurs on gently undulating rises over Wianamatta Group shales. The ground slopes are usually less than 5% and the vegetation typically comprises partly cleared eucalypt, woodlands and tall open forests. The soils range from shallow to moderately deep (less than 1m thick) and are hard setting, mottled textured clay soils. The soils are typically moderately reactive with a highly plastic subsoil, have a low soil fertility and poor soil drainage.

The South Creek soil landscape group occurs in flood plains, valley flats and drainage depressions or channels on the Cumberland Plain. The soils are often deep, layered sediments overlying bedrock or relict soils. The main limitations of this soil landscape are the risk of erosion and frequent flooding.

4. FIELD WORK METHODS

A truck-mounted drilling rig was used to drill four bores (Bores 1 to 4) in February 2003 to depths of 8 m. The bores were drilled using spiral flight augers through the soils and were then continued using rotary drilling techniques in the underlying rock. Standard penetration tests were carried out at depths of 0.5 m and 2 m within the soils.

The locations of these bores are shown on Drawing 3 in Appendix A. The locations were measured using a tape from existing site features and the levels of the tests were measured using a dumpy level relative to a permanent survey mark located at the intersection of Glendenning Road and Woodstock Avenue.

A further five shallow bores (Bores 101 to 105) were drilled in May 2005 on the small section of the site between Kellogg Road and Woodstock Road. These bores were drilled using an auger attached to a bobcat and were drilled to depths of 1.8 m to 3.0 m. Samples of the soils from these bores were submitted to a laboratory for testing for hydrocarbons. The locations of these bores are shown on Drawing 4 in Appendix A.

5. FIELD WORK RESULTS

Details of the conditions encountered in the test bores are given in the test report sheets in Appendix B, together with notes defining the terms used to classify the strata.

The bores on the main part of the site intersected relatively uniform conditions across the site with depths to rock generally increasing on the lower parts of the site. In summary the subsurface conditions encountered by the bores comprised:

- TOPSOIL - 0.1-0.6 m dark brown clay topsoil
- CLAY - stiff to very stiff clays to depths of 2 m to 3.9 m. In Bores 2, 3 and 4 the clays included some silt and/or sand, indicating that they might be alluvial in origin.
- SHALE - weathered brown and grey shale

The bores on the smaller portion of the site between Kellogg Road and Woodstock Road intersected natural silty clays or clay and sand filling over the natural silty clays.

6. GROUNDWATER

No free groundwater was observed during drilling of the bores but standpipe piezometers were installed in all four of the deep bores. Measurements were taken of water levels following the completion of drilling and also after development of the bores, that is after the bores were pumped dry and allowed to recover. The measured water levels are given in Table 1 below.

Table 1 - Groundwater levels

Bore	Surface RL (m)	Water level (m)	
		25/3/03	9/4/03
1	39.38	32.58	32.55
2	34.02	32.61	32.23
3	32.87	31.65	31.22
4	33.93	31.52	31.15

These levels indicate that there is a gradual fall in the level of the water table to the east and south-east, towards the drainage channel. This is consistent with expectations that the groundwater table is a subdued reflection of the surface topography.

7. LABORATORY TESTING

Samples of the near surface soils were collected from each of the bores on the main part of the site and tested for a standard suite of anions and cations to assess the salinity of the soils. The detailed laboratory results are given in Appendix C and are summarised in Table 2 below.

Table 2 - Chemical Analysis of Soil Samples

Bore/Depth (m)	EC (μS/cm)	Ca++ (mg/kg)	Na+ (mg/kg)	K+ (mg/kg)	SO^{--}_4 (mg/kg)	Cl^- (mg/kg)
1/0.1	96	720	410	1100	88	38
1/0.5	270	550	700	900	170	270
2/0.1	67	330	190	320	25	48
2/0.5	380	130	1000	360	93	490
3/0.1	750	10000	1500	1500	510	490
3/0.5	470	180	1800	630	210	540
4/0.1	39	2400	200	430	8.1	15
4/0.5	140	1600	780	600	38	130

EC = Electrical Conductivity

Samples of the groundwater were collected from each of the deep bores and were tested for a standard suite of possible contaminants. The detailed laboratory test results are given in Appendix D and are summarised in Tables 3, 4 and 5 below.

Table 3 - Heavy Metals in Water Samples

Bore	As (mg/l)	Cd (mg/l)	Ch (mg/l)	Cu (mg/l)	Pb (mg/l)	Ni (mg/l)	Zn (mg/l)	Hg (mg/l)
1	<0.005	<0.0002	<0.005	0.002	<0.001	<0.005	0.015	<0.0001
2	<0.005	<0.0002	<0.005	0.004	<0.001	0.01	0.048	<0.0001
3	<0.005	<0.0002	<0.005	0.002	<0.001	0.01	0.047	<0.0001
4	<0.005	<0.0002	<0.005	0.002	0.002	0.006	0.064	<0.0001
Trigger values for freshwater aquatic ecosystems - 95% protection	0.013	0.0002	0.001	0.0014	0.0034	0.011	0.008	0.0006

These results indicate that there are elevated levels of zinc in the existing groundwater and slightly elevated levels of copper.

Table 4 - Hydrocarbons in Water Samples

Bore	TRH C6-C9 (mg/l)	TRH C10-C14 (mg/l)	TRH C15-C28 (mg/l)	TRH C29-C36 (mg/l)	Benzene (mg/l)	Toluene (mg/l)	Ethylbenzene (mg/l)	Total Xylenes (mg/l)
1	<0.04	<0.1	<0.2	<0.2	<0.001	<0.001	<0.001	<0.003
2	<0.04	<0.1	<0.2	<0.2	<0.001	<0.001	<0.001	<0.003
3	<0.04	<0.1	<0.2	<0.2	<0.001	<0.001	<0.001	<0.003
4	<0.04	<0.1	<0.2	<0.2	<0.001	<0.001	<0.001	<0.003

The results indicate that there were no discernible hydrocarbons in the water samples tested.

Table 5 - pH, EC and TDS of Water Samples

Bore	pH	EC (μS/cm)	TDS (mg/l)
1	7.0	4500	3200
2	7.1	16000	11000
3	6.9	10000	6000
4	7.2	10000	6100

The results indicate that the samples of groundwater had neutral pH values but were highly saline.

In addition soil samples from the shallow bores on the small portion of the site between Kellogg Road and Woodstock were tested for hydrocarbons. The detailed results of the testing are given in Appendix D and are summarised in Table 6 below.

Table 6 - Hydrocarbons in Soil Samples

Bore	Depth (m)	TRH C6-C9 (mg/kg)	TRH C10-C14 (mg/kg)	TRH C15-C28 (mg/kg)	TRH C29-C36 (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)
101	0.2-0.5	<20	<20	<50	<50	<0.5	<0.5	<0.5	<1.5
102	0.2-0.5	<20	<20	<50	<50	<0.5	<0.5	<0.5	<1.5
103	0.2-0.5	<20	<20	<50	<50	<0.5	<0.5	<0.5	<1.5
104	0.2-0.5	<20	<20	<50	<50	<0.5	<0.5	<0.5	<1.5
104	1.0-1.5	<20	<20	<50	<50	<0.5	<0.5	<0.5	<1.5
105	0.2-0.5	<20	<20	140	260	<0.5	<0.5	<0.5	<1.5

Only two fractions from one sample were measured above the detection limits, and both of these are well below the acceptance criteria from the relevant guidelines.

8. PROPOSED DEVELOPMENT

It is understood that the proposed development for the site is to include:

- an office building with a concrete testing laboratory
- a concrete batching plant;
- a rail siding for aggregate unloading;
- storage bins and load out facilities;
- a conveyor system linking the unloading station and the storage bins;
- blending plant;
- workshop, stores, weighbridge and truck maintenance facilities
- two bridges over Angus Creek; and
- realignment of North Parade.

9. GEOLOGICAL AND GROUNDWATER ASSESSMENT

9.1 Geological Model

The site is mostly located on a gently sloping hillside which falls towards the south-east where a local drainage channel crosses the site, flowing in a north-easterly direction towards Eastern Creek.

The whole of the site is underlain by weathered rocks of the Bringelly Shale formation, the upper member of the Wianamatta Group of sedimentary rocks laid down during the Triassic period. These rocks typically comprise beds of dark grey to black siltstone, claystone, finely interlaminated siltstone and sandstone (laminite), shale and fine grained sandstone. Based on information from other sites in the area it is expected that the bedrock will be typically highly to moderately weathered at the surface but that it will be typically slightly weathered or fresh within a few metres of the top of the bedrock surface.

Clay soils overlie the shale bedrock over all of the site. While it is difficult to distinguish between the different clays, it is expected that most of the clays on the lower, southern part of the site are alluvial in origin and contain lenses of sand and silt, while the clays on the higher, northern part of the site are residual, that is, they are derived from in-situ weathering of the underlying shale bedrock.

The thickness of the clay soils typically ranged from 2.0 m to 3.9 m and the soils were consistently stiff to very stiff. Observations of the soils on the site and laboratory testing carried out during the Coffey investigation indicates that the clays are typically highly reactive.

At the time of the investigation there were large mounds of filling present on the northern half of Lot 5. These mounds were up to 4 m high and it is understood that the filling was derived from excavations undertaken on the adjacent Onesteel site. It is therefore anticipated that the filling probably mostly comprises clay soils and weathered shale and sandstone. It is not known whether the filling was compacted, but visual observations suggest not.

9.2 Groundwater

The regional drainage pattern comprises a series of major drainage channels, including Eastern Creek, which flow in a northerly direction across the Cumberland Plain. The site is located just to the west of Eastern Creek, and is bisected by a local drainage channel or tributary of Eastern Creek which flows in a north-easterly direction across the site towards Eastern Creek.

Measured groundwater levels in the bores indicate that the groundwater levels are a subdued reflection of the surface topography, with the depths to groundwater typically 1-2 m on the lower parts of the site and up to about 7 m below the higher parts of the site. The direction of flow of the groundwater is to the south-east and east, towards the local drainage channel and then towards Eastern Creek.

Chemical tests on samples of the groundwater indicate that the groundwater is highly saline, as is typical of groundwater within the Wianamatta Group of rocks, and the groundwater also contains slightly elevated levels of zinc and copper.

Numerous investigations by Douglas Partners in the western parts of Sydney underlain by Bringelly Shale and Ashfield Shale have found degraded water quality due to naturally occurring factors relating to the marine environment which prevailed during much of the Triassic period. Salt deposited in the interstitial pore spaces of the shale beds during formation has not been fully leached owing to the low permeability of these materials and the fact that the major cations are bonded to the clay mineral structure by electrostatic forces. The saline depositional conditions have caused the high salinity measured in the soil and groundwater over the entire western area of Sydney.

In 1942 A N Old published a paper in the Agricultural Gazette which studied the salt content of groundwater in the Wianamatta Shale. This study collected information from groundwater bores dating back to 1894 and found that the total dissolved solids in the water varied from 47,600 mg/l at Toongabbie down to 11,500 mg/l at Riverstone with the overall trend showing an increase towards the centre of the basin around Merrylands/Wetherill Park/Toongabbie.

The overall salinity of the groundwater in the western suburbs of Sydney is well established with few water bores located east of the Nepean River. The low rate of leaching of the high salt

concentrations will ensure that without treatment the groundwater in this region remains unsuitable for agricultural, horticultural or farming use into the foreseeable future.

9.3 Soil Salinity

Laboratory testing of soil samples for conductivity and a range of anions and cations gave variable results ranging from slightly to moderately saline. The level of salinity in the soil is consistent with the concentration of total dissolved solids recorded in groundwater samples taken from this site and other sites in the region.

The salinity of the soil in western Sydney has been recognized for a long time with some reference to soil salinity given in historical documents from the early 1800s. The fact that there are many salt tolerant native plants suggests that the salty soils and groundwater are naturally occurring, although it is recognised that urban development and land clearing can exacerbate the problem. Work published by the Department of Lands and Water Conservation in 1997 identified 4500 hectares of land affected by salinity with a further 19,000 hectares potentially affected.

The model for dryland salinity which has received the most recognition in recent times postulates that the removal of vegetation from hillsides has been accompanied by a rising water table on the lower slopes due to lower evapotranspiration. The rising groundwater has brought salt to the surface which has then caused dieback of the remaining native vegetation and results in increased soil erosion. Salinity can also be evident where deep excavations take place through the B soil horizon so that seepage emanates from the cutting face. This seepage carries with high salt concentrations which are deposited by evaporation in the groundwater discharge zone.

Salinity has been recognised as a regional problem in western Sydney and a Draft Salinity Code of Practice has been published by the Western Sydney Regional Organisation of Councils (WSROC). The Code of Practice deals with development assessment and control measures. It also recommends a level of site investigation to make a proper assessment of sites. This includes determining the geology, soils, climate, hydrology, soil water and hydrogeology. The current investigation has satisfied these recommendations in so far as it has reviewed all the

previous investigations together with the current investigation and has established existing soil and groundwater conditions as a baseline for future monitoring.

The soil management principles outlined in the Draft Code of Practice identify a number of important areas which require consideration. These are:

- identify hazard areas and processes on the site
- reduce water input and maintain the natural water balance that limits groundwater rise and soil water through flow
- maintain good drainage and reduce water logging
- retain or increase vegetation in strategic areas, and
- implement building controls and/or engineering responses where appropriate.

When the final design of the facilities is being completed, these principles will need to be incorporated into the site management regime.

9.4 Acid Sulphate Soils

Based on observations of the soils encountered in the bores and the elevation of the site it is considered that there is a very low risk of acid sulphate soils being found on the site.

Acid sulphate soils are typically formed in coastal areas below about RL 5, along estuaries and rivers. Recently there has been evidence to suggest that pyrite, which can potentially become oxidised during disturbance to form acid sulphate soils, may be present at elevations as high as RL 12. The subject site, however, is above RL 30 which means that it is well above all the previous areas where acid sulphate soils have been found.

The Department of Land and Water Conservation has prepared a series of Acid Sulphate Soil Risk Maps for the Sydney Metropolitan and Suburban Areas. The maps, however, do not extend further west than Prospect/Parramatta indicating that the risk is confined to the main river systems and coastal regions.

9.5 Development of the Site

It is considered that, from a geotechnical viewpoint, the site can be developed as proposed. It is recommended, however, that the following comments be considered during design and construction:

- the clay soils are highly reactive and will be subject to significant shrink and swell movements when there are changes in the moisture content of the soils, and footings of structures will need to be designed to withstand any such movements;
- the low lying nature of the site means that there may be frequent flooding of lower areas of the site which could lead to erosion of soils as well as periodically increasing the moisture content of the soils if and when vegetative cover is removed;
- the filling mounds on the site are unlikely to have been compacted or placed at the optimum moisture content, so it is likely that these materials will have to be reworked,
- the moisture content of any filling using the clay soils from this site or adjacent sites will need to be carefully controlled.

Site specific investigations will be needed for each individual structure when engineering designs are being prepared.

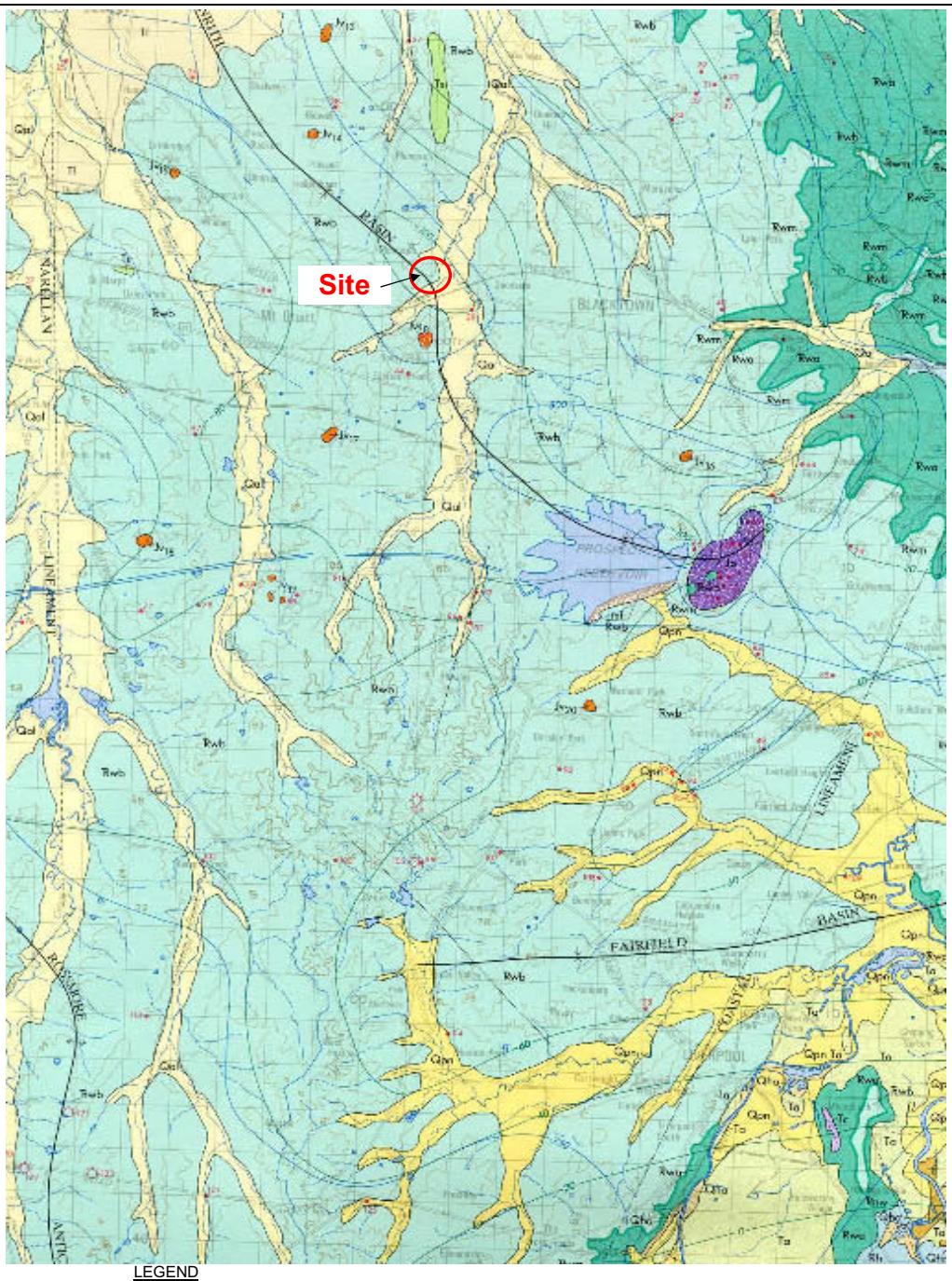
DOUGLAS PARTNERS PTY LTD

Reviewed by

Fiona MacGregor
Principal

Michael J Thom
Principal

APPENDIX A
Drawings



LEGEND

Qal - Quaternary Alluvium (sand, silt and clay)

Jv - Volcanic breccia and basalt

Rwb - Bringelly Shale (shale, claystone and laminite)

Rwa - Ashfield Shale (claystone, siltstone and laminite)

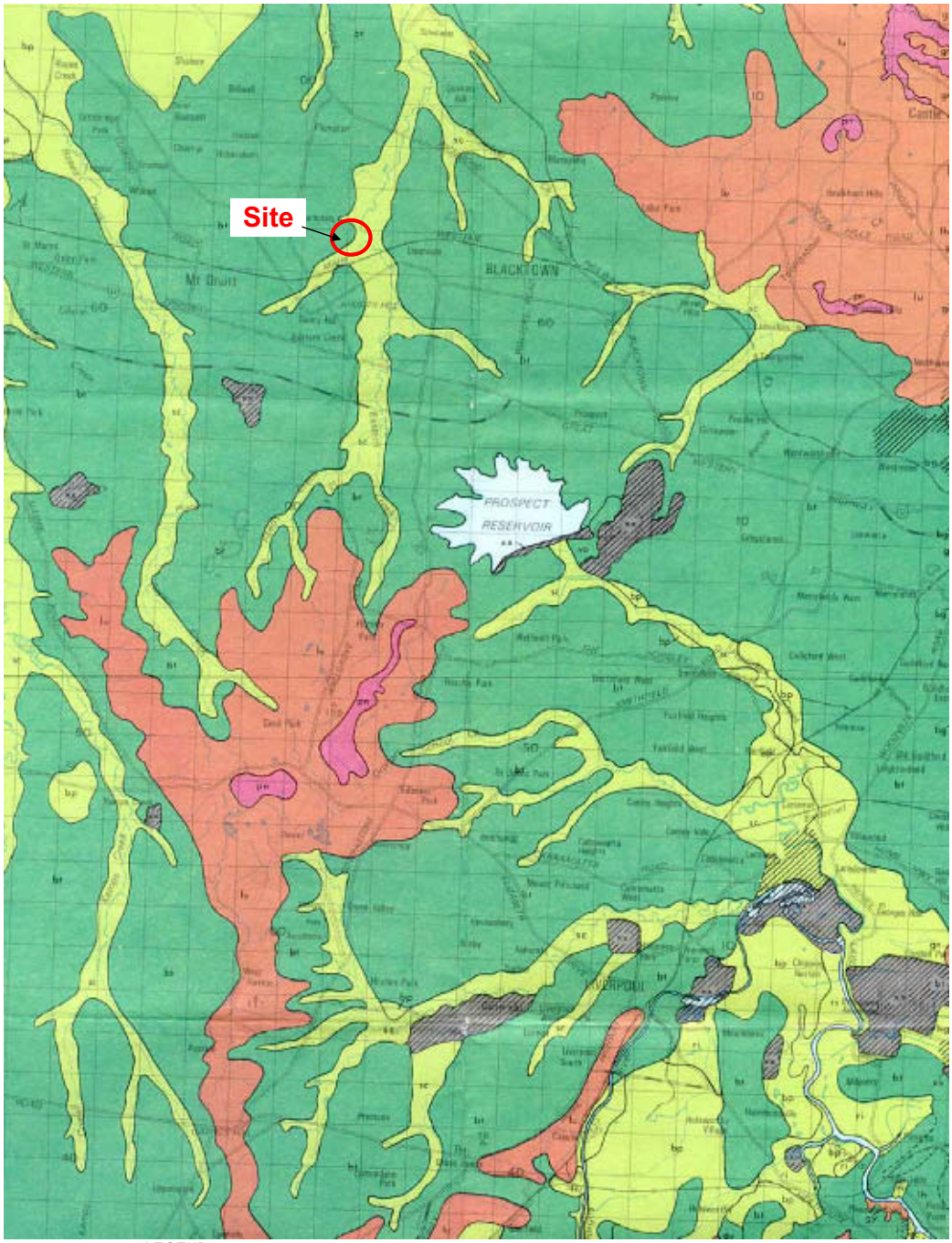
Map taken from Penrith 1:100 000 Geological Series Sheet 9030

Douglas Partners
Geotechnics · Environment · Groundwater

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

Title **Regional Geology**
Geological & Groundwater Assessment
Kellogg Road, Rooty Hill

Client: Readymix			Office: Sydney
Drawn by: FM	Scale: NTS	Project Number: 37916	Drawing No. 1
Approved by:		Date: March 2005	



LEGEND

sc - South Creek Landscape (Fluvial - erosion hazard, frequent flooding)

bt - Blacktown Landscape (Residual - moderately reactive, poor soil drainage)

lu - Luddenham Landscape (Erosional - high erosion hazard, moderately reactive)

pn - Picton Landscape (Colluvial - slump hazard, high erosion hazard)

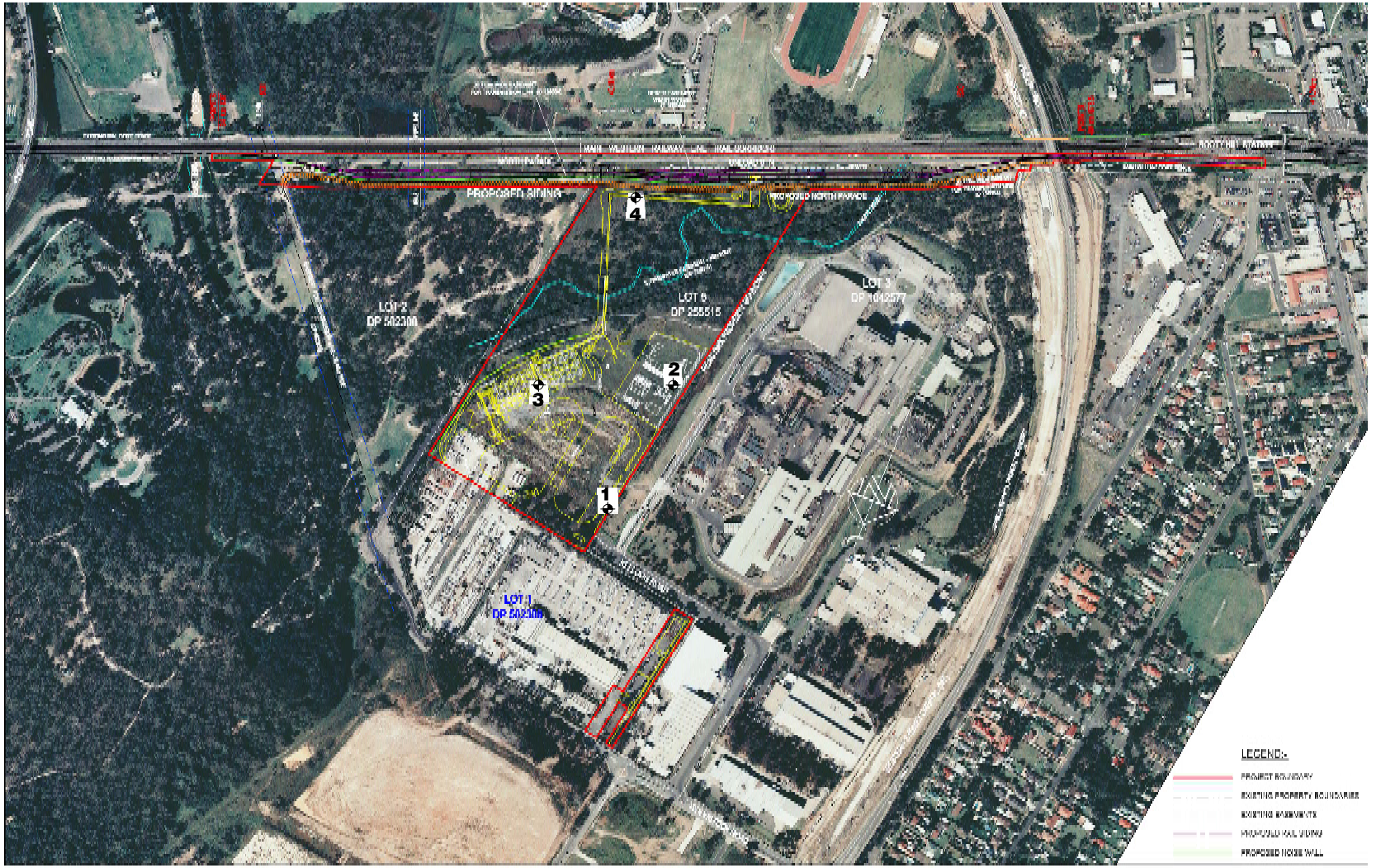
Map taken from Soil Conservation Service NSW, Penrith Soil Landscape Series Sheet 9030

Douglas Partners
Geotechnics · Environment · Groundwater

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

Title **Regional Soils Map**
Geological & Groundwater Assessment
Kellogg Road, Rooty Hill

Client: Readymix			Office: Sydney
Drawn by: FM	Scale: NTS	Project Number: 37916	Drawing No. 2
Approved by:		Date: March 2005	



LEGEND

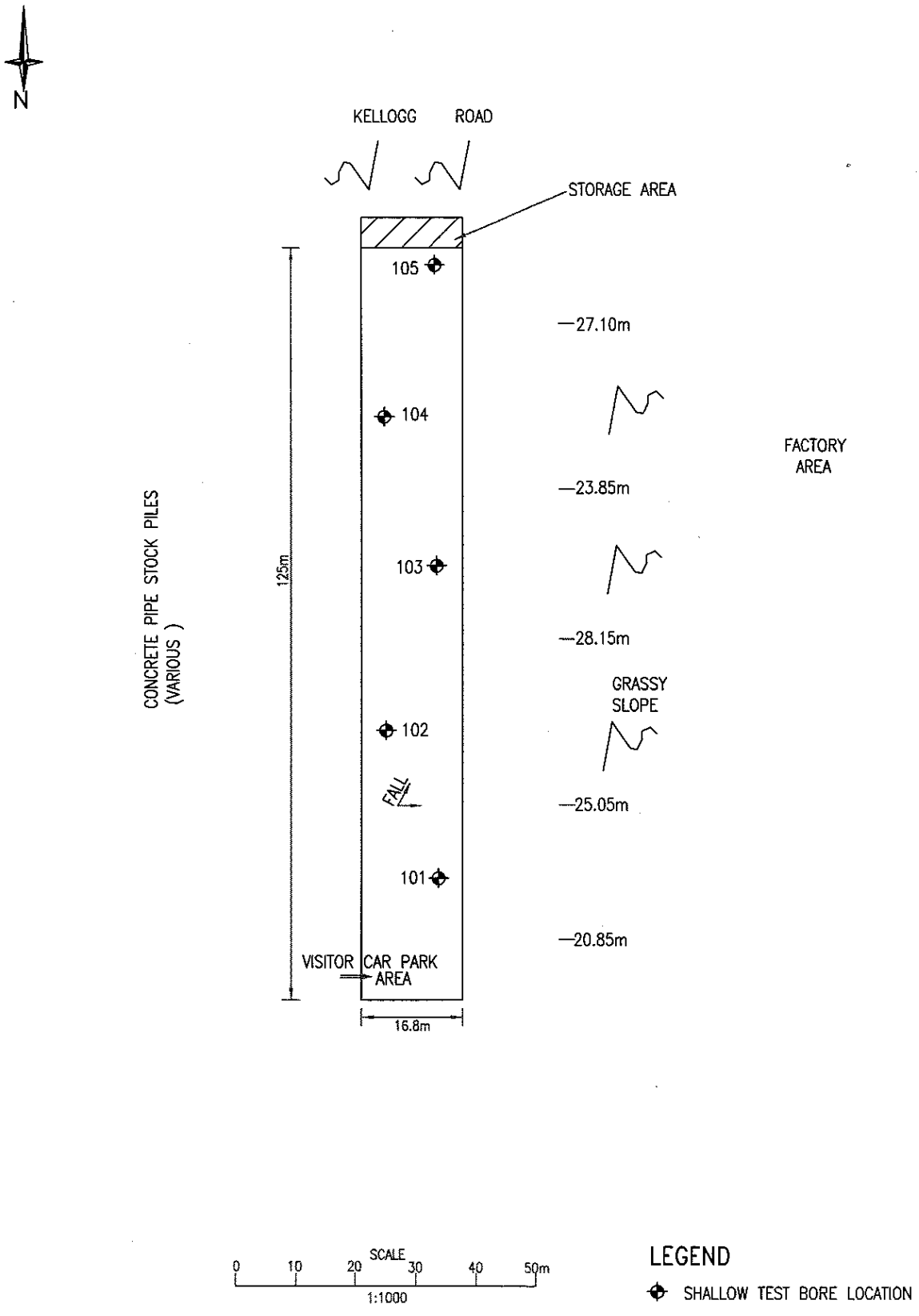
◆ TEST BORE LOCATION

Douglas Partners
Geotechnics, Environment, Groundwater

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

TITLE:
Location of Test Bores
Geological Groundwater Assessment
Kellogg Road
ROOTY HILL

CLIENT: Readymix			
DRAWN BY: PSCH	SCALE: N.T.S.	PROJECT No: 37916	OFFICE: SYDNEY
APPROVED BY:		DATE: 15.3.2005	DRAWING No: 3



Douglas Partners
Geotechnics, Environment, Groundwater

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

TITLE: Location of Shallow Test Bores
Geological and Groundwater Assessment
Kellogg Road - ROOTY HILL

CLIENT: Readymix			OFFICE: SYDNEY
DRAWN BY: GJH	SCALE: 1:1000	PROJECT No: 37916	DRAWING No: 4
APPROVED BY:		DATE: 2.6.2005	

P:\37916 ROOTY HILL, Readymix FM\Drawings\37916-4.dwg, 6/2/2005 11:51:42 AM

APPENDIX B
Test Bore Reports

TEST BORE REPORT

CLIENT: NECS
PROJECT: GROUNDWATER STUDY – READYMIX
LOCATION: KELLOGG RD, ROOTY HILL

DATE: 28 FEBRUARY 03
PROJECT No.: 35841
SURFACE LEVEL: 39.38

BORE No. 1
SHEET 1 **OF** 1

Depth m	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results	Core Recovery %
0					
0.2	CLAY – dark brown clay with some silt and a trace of sand and roots. Moist	A	0.1		
		A	0.4		
	CLAY – stiff to very stiff, light grey and red brown mottled clay with some ironstone gravel. Dry	S	0.5	4,8,8 N=16	
1		A	0.95		
			1.0		
2					
2.0	SHALE – low to medium strength, brown and grey shale with ironstone gravel	S	2.0	25/110mm refusal	
			2.45		
3					
4					
5					
6					
7					
8					
8.0	TEST BORE DISCONTINUED AT 8.0 METRES				
9					
10					

RIG: SCOUT **DRILLER:** J WARD **LOGGED:** JARDINE **CASING:** TO 2.5m
TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.0m ROTARY TO 8.0m
GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	M Moisture content (%)
B Bulk sample	pp Pocket Penetration (kPa)
D Disturbed sample	Ux x mm dia. tube
HV Hand Vane	Wp Plastic limit (%)

CHECKED:
Initials:
Date: 4/03

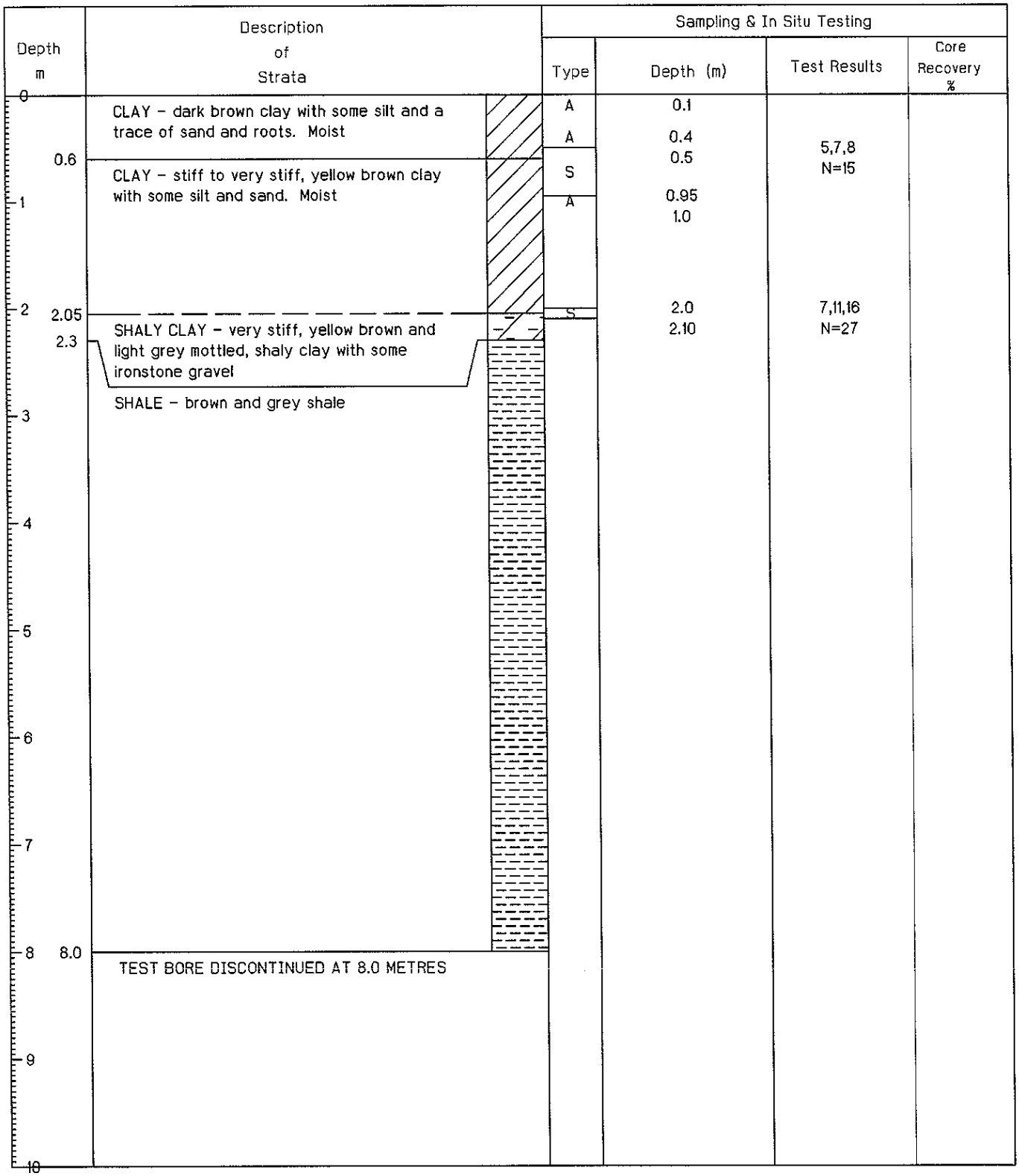
Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

CLIENT: NECS
PROJECT: GROUNDWATER STUDY - READYMIX
LOCATION: KELLOGG RD, ROOTY HILL

DATE: 27 FEBRUARY 03
PROJECT No.: 35841
SURFACE LEVEL: 34.02

BORE No. 2
SHEET 1 OF 1



RIG: SCOUT **DRILLER:** J WARD **LOGGED:** JARDINE **CASING:** TO 3.0m
TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.5m ROTARY TO 8.0m
GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED
REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A Auger sample	M Moisture content (%)
B Bulk sample	pp Pocket Penetration (kPa)
D Disturbed sample	Ux x mm dia. tube
HV Hand Vane	Wp Plastic limit (%)

CHECKED:
Initials: AM
Date: 4/03

Douglas Partners
Geotechnics • Environment • Groundwater

TEST BORE REPORT

CLIENT: NECS
PROJECT: GROUNDWATER STUDY - READYMIX
LOCATION: KELLOGG RD, ROOTY HILL

DATE: 28 FEBRUARY 03
PROJECT No.: 35841
SURFACE LEVEL: 32.87

BORE No. 3
SHEET 1 **OF** 1

Depth m	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results	Core Recovery %
0					
0.1	CLAY - dark brown clay with some silt and a trace of sand and roots. Moist	A	0.1		
		A	0.4		
	CLAY - stiff, yellow brown clay with some silt and a trace of ironstone gravel. Moist	S	0.5	3,4,5 N=9	
1		A	0.95		
			1.0		
2.0		S	2.0	4,5,9 N=14	
	CLAY - stiff, light grey mottled yellow brown clay with some silt and ironstone gravel. Moist		2.45		
3					
3.9	SHALE - brown and grey shale				
4					
5					
6					
7					
8.0	TEST BORE DISCONTINUED AT 8.0 METRES				
8					
9					
10					

RIG: SCOUT **DRILLER:** J WARD **LOGGED:** JARDINE **CASING:** TO 2.5m
TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.0m ROTARY TO 8.0m
GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	M Moisture content (%)
B Bulk sample	pp Pocket Penetration (kPa)
D Disturbed sample	Ux x mm dia. tube
HV Hand Vane	Wp Plastic limit (%)

CHECKED:
Initials: JM
Date: 4/03

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

CLIENT: NECS
PROJECT: GROUNDWATER STUDY – READYMIX
LOCATION: KELLOGG RD, ROOTY HILL

DATE: 3 MARCH 03
PROJECT No.: 35841
SURFACE LEVEL: 33.93

BORE No. 4
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results	Core Recovery %
0					
0.3	CLAY – dark brown clay with some silt and a trace of sand and roots. Dry	A	0.1		
		A	0.4		
		S	0.5	3,7,12 N=19	
0.9	CLAY – very stiff, yellow brown clay with some silt and a trace of sand and roots. Dry	A	0.95		
1			1.0		
	CLAY – stiff to very stiff, yellow brown and light grey (minor) clay, slightly sandy with some ironstone gravel. Moist				
2		S	2.0	1,5,9 N=14	
			2.45		
3					
3.4	SHALE – brown and grey shale				
4					
5					
6					
7					
8	8.0 TEST BORE DISCONTINUED AT 8.0 METRES				
9					
10					

RIG: SCOUT **DRILLER:** J WARD **LOGGED:** JARDINE **CASING:** TO 2.5m
TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.0m ROTARY TO 8.0m
GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	M Moisture content (%)
B Bulk sample	pp Pocket Penetration (kPa)
D Disturbed sample	Ux x mm dia. tube
HV Hand Vane	Wp Plastic limit (%)

CHECKED:
Initials: MM
Date: 4/03

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: NECS
PROJECT: Geological and Groundwater Assessment
LOCATION: Kellogg Road, Rooty Hill

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

BORE No: 101
PROJECT No: 37916
DATE: 23 May 05
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT							
		ROADBASE - green grey			0.2		PID<1		
	0.4	SILTY CLAY - red brown and grey silty clay with trace of ironstone gravel and some ironstone bands		A	0.5				
	1				1.0		PID<1		1
				A					
					1.5				
	2				2.0		PID<1		2
				A					
	2.5	Bore discontinued at 2.5m - refusal			2.5				
	3								3
	4								4

RIG: Bobcat
DRILLER: Ellis
LOGGED: Woodley
CASING: Uncased
TYPE OF BORING: Solid Flight Auger
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	05/05

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: NECS
PROJECT: Geological and Groundwater Assessment
LOCATION: Kellogg Road, Rooty Hill

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

BORE No: 102
PROJECT No: 37916
DATE: 23 May 05
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT							
		ROADBASE - with trace of slag			0.2		PID<1		
	0.4	SILTY CLAY - red brown and grey silty clay with some ironstone bands		A*	0.5				
	1				1.0		PID<1		1
				A					
					1.5		PID<1		
				A					
	1.8	Bore discontinued at 1.8m			1.8				
	2								2
	3								3
	4								4

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Woodley **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger

WATER OBSERVATIONS:

REMARKS: * Denotes field replicate Z1

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED
Initials:
Date: 05/05

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: NECS
PROJECT: Geological and Groundwater Assessment
LOCATION: Kellogg Road, Rooty Hill

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

BORE No: 103
PROJECT No: 37916
DATE: 23 May 05
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT							
		ROADBASE - crushed sandstone			0.2		PID<1		
				A					
	0.6				0.5				
		FILLING - green grey sand with some clay and trace of fine gravel							
	1				1.0		PID<1		1
				A					
					1.5				
	1.8	SILTY CLAY - grey and red and orange brown silty clay							
	2				2.0		PID<1		2
				A					
	3	3.0 Bore discontinued at 3.0m			3.0				3
	4								4

RIG: Bobcat
DRILLER: Ellis
LOGGED: Woodley
CASING: Uncased
TYPE OF BORING: Solid Flight Auger
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 05/05

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: NECS
PROJECT: Geological and Groundwater Assessment
LOCATION: Kellogg Road, Rooty Hill

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

BORE No: 104
PROJECT No: 37916
DATE: 23 May 05
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT		A	0.0		PID<1		
		FILLING - yellow brown and grey sand with some clay			0.05				
	0.8	FILLING - dark grey green clay (filling) with occasional fine gravel and a slight odour							
	1				1.0		PID<1		1
				A					
					1.5				
	2	2.0 SILTY CLAY - red brown and grey silty clay			2.0		PID<1		2
				A					
	3	3.0 Bore discontinued at 3.0m			3.0				3
	4								4

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Woodley **CASING:** Uncased
TYPE OF BORING: Solid Flight Auger
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AT
Date: 05/05

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: NECS
PROJECT: Geological and Groundwater Assessment
LOCATION: Kellogg Road, Rooty Hill

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

BORE No: 105
PROJECT No: 37916
DATE: 23 May 05
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT							
		FILLING - grey brown silty clay with some sand and occasional fine gravel		A	0.2		PID<1		
					0.5				
	0.9	FILLING - red brown and grey silty clay							
1				A	1.0		PID<1		1
					1.5				
	1.7	FILLING							
2				A	2.0		PID<1		2
3	3.0	Bore discontinued at 3.0m			3.0				3
4									4

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Woodley **CASING:** Uncased
TYPE OF BORING: Solid Flight Auger
WATER OBSERVATIONS:
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

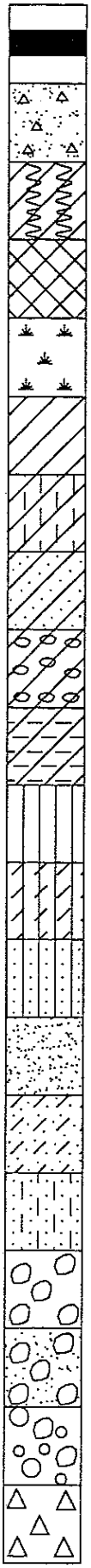
A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 05/05

Douglas Partners
Geotechnics · Environment · Groundwater

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

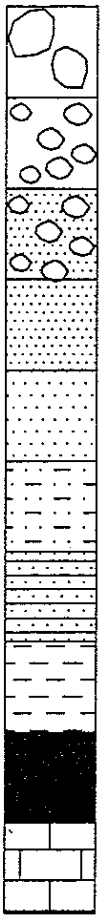
GRAVEL

SANDY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

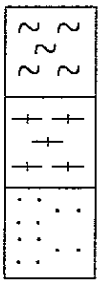
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

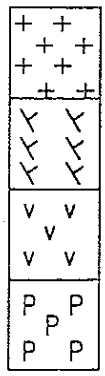


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

SEAMS

SEAM >10mm

SEAM <10mm

Douglas Partners

Geotechnics, Environment, Groundwater

Douglas Partners
Geotechnics · Environment · Groundwater

DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

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

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

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

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

APPENDIX C
Laboratory Testing

27 March 2003

TEST REPORT

Douglas Partners Pty Ltd
96 Hermitage Road
WEST RYDE
NSW 2114

Your Reference: 35841, Rooty Hill
Report Number: 22387

Attention: Fiona McGregor

Dear Fiona
The following samples were received from you on the date indicated.

Samples: Qty.	8 Soils
Date of Registration	25/03/03
Date of Receipt of Samples:	25/03/03@10am
Date of Receipt of Instructions:	25/03/03
Date Preliminary Report Faxed:	26/03/03

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Tania Notaras
Manager Sydney

Jacinta Hurst
Operations Manager

Analabs Pty Ltd ABN 91 004 591 664
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 www.sgs.com

Inorganics Our Reference: Your Reference	UNITS --- ---	22387-1 1/0.1	22387-2 1/0.5	22387-3 2/0.1	22387-4 2/0.5	22387-5 3/0.1
Electrical Conductivity 1:5 soil:water	µS/cm	96	270	67	380	750

Inorganics Our Reference: Your Reference	UNITS --- ---	22387-6 3/0.5	22387-7 4/0.1	22387-8 4/0.5
Electrical Conductivity 1:5 soil:water	µS/cm	470	39	140

Method ID	Methodology Summary
SEI-010	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 20th ED, 1050-A, 1030-F.

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Registration
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

Date Organics extraction commenced: N/A
NATA Accreditation No. 2562

Quality Control Protocol

Reagent Blank: Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.

Matrix Spike Duplicates: Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.

Surrogate Spike: Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.

Internal Standard: Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.

Control Standards: Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity.

Additional QC Samples: A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.

Statistical Analysis of QC Data: Quality control data is plotted on control charts using the APHA procedure with warning and control limits at 2 and 3 standard deviations respectively.

9 April 2003

TEST REPORT

Douglas Partners Pty Ltd
96 Hermitage Road
WEST RYDE
NSW 2114

Your Reference: 35841, Rooty Hill
Report Number: 22387A

Attention: Julius Pucci

Dear Julius
The following samples were received from you on the date indicated.

Samples: Qty.	8 Soils
Date of Registration	8/04/03
Date of Receipt of Samples:	25/03/03
Date of Receipt of Instructions:	08/04/03
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Tania Notaras
Manager Sydney

Jacinta Hurst
Operations Manager

Inorganics Our Reference: Your Reference	UNITS ----------	22387A-1 1/0.1	22387A-2 1/0.5	22387A-3 2/0.1	22387A-4 2/0.5	22387A-5 3/0.1
Calcium by AAS	mg/kg	720	550	330	130	10000
Sodium	mg/kg	410	700	190	1000	1500
Potassium by AAS	mg/kg	1100	900	320	360	1500
Sulphate, SO4* 1:5 soil:water	mg/kg	88	170	25	93	510
Chloride, Cl* 1:5 soil:water	mg/kg	38	270	48	490	490

Inorganics Our Reference: Your Reference	UNITS ----------	22387A-6 3/0.5	22387A-7 4/0.1	22387A-8 4/0.5
Calcium by AAS	mg/kg	180	2400	1600
Sodium	mg/kg	1800	200	780
Potassium by AAS	mg/kg	630	430	600
Sulphate, SO4* 1:5 soil:water	mg/kg	210	8.1	38
Chloride, Cl* 1:5 soil:water	mg/kg	540	15	130

Method ID	Methodology Summary
SEM-001	Metals - Determination of various metals using Air / Acetylene Flame Atomic Absorption Spectroscopy. In accordance with APHA 20th ED, 3111A, C.
SEI-038	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 20th ED, 4110 -B.

QUALITY CONTROL Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
Calcium by AAS	mg/kg	1	SEM-001	<1	Nil Rep.	Nil Rep.	Sand	103 || 104 || RPD: 1
Sodium	mg/kg	0.2	SEM-001	<0.2	Nil Rep.	Nil Rep.	Sand	97 || 98 || RPD: 1
Potassium by AAS	mg/kg	3	SEM-001	<3	Nil Rep.	Nil Rep.	Sand	92 || 93 || RPD: 1
Sulphate, SO4* 1:5 soil: water	mg/kg	2	SEI-038	<2.0	Nil Rep.	Nil Rep.	[NR]	[NR]
Chloride, Cl* 1:5 soil:water	mg/kg	0.5	SEI-038	<0.50	Nil Rep.	Nil Rep.	[NR]	[NR]

Result Codes

[INS] : Insufficient Sample for this test
[NR] : Not Requested
[NT] : Not tested
[HBG] : Results not Reported due to High Background Interference
* : Not part of NATA Registration
[N/A] : Not Applicable

Result Comments

Date Organics extraction commenced: N/A
NATA Accreditation No. 2562

Quality Control Protocol

Reagent Blank: Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.
Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.
Matrix Spike Duplicates: Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.
Surrogate Spike: Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.
Internal Standard: Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.
Control Standards: Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity.
Additional QC Samples: A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.
Statistical Analysis of QC Data: Quality control data is plotted on control charts using the APHA procedure with warning and control limits at 2 and 3 standard deviations respectively.

21 March 2003

TEST REPORT

Douglas Partners Pty Ltd
96 Hermitage Road
WEST RYDE
NSW 2114

Your Reference: 35841, Rooty Hill
Report Number: 22262

Attention: Julius Pucci

Dear Julius
The following samples were received from you on the date indicated.

Samples: Qty.	4 Waters
Date of Registration	17/03/03
Date of Receipt of Samples:	14/03/03
Date of Receipt of Instructions:	14/03/03
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

pp
Tania Notaras
Manager Sydney

pp Jacinta Hurst
Operations Manager

Analabs Pty Ltd
ABN 91 004 591 664
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 www.sgs.com
Member of the SGS Group (Société Générale de Surveillance)

AEL Ref	Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
---	---	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22262-1	BH1	<0.005	<0.0002	<0.005	0.002	<0.001	<0.005	0.015	<0.0001
22262-2	BH2	<0.005	<0.0002	<0.005	0.004	<0.001	0.01	0.048	<0.0001
22262-3	BH3	<0.005	<0.0002	<0.005	0.002	<0.001	0.01	0.047	<0.0001
22262-4	BH4	<0.005	<0.0002	<0.005	0.002	0.0020	0.006	0.064	<0.0001

AEL Ref	Sample ID	TRH C6 - C9 P&T	TRH C10 - C14	TRH C15 - C28	TRH C29 - C36	Benzene	Toluene	Ethylbenzene	Total Xylenes
---	---	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22262-1	BH1	<0.040	<0.10	<0.20	<0.20	<0.001	<0.001	<0.001	<0.003
22262-2	BH2	<0.040	<0.10	<0.20	<0.20	<0.001	<0.001	<0.001	<0.003
22262-3	BH3	<0.040	<0.10	<0.20	<0.20	<0.001	<0.001	<0.001	<0.003
22262-4	BH4	<0.040	<0.10	<0.20	<0.20	<0.001	<0.001	<0.001	<0.003

AEL Ref	Sample ID	pH	Electrical Conductivity	Total Dissolved Solids
---	---	pH Units	µS/cm	mg/L
22262-1	BH1	7.0	4500	3200
22262-2	BH2	7.1	16000	11000
22262-3	BH3	6.9	10000	6000
22262-4	BH4	7.2	10000	6100

Method ID	Methodology Summary
Ext-018	Subcontracted to Gribbles Analytical (VIC).
SEO-017	BTEX/TRH C6-C9 - Determination by Purge and Trap Gas Chromatography with Flame Ionisation Detection (FID) and Photo Ionisation Detection (PID). The surrogate spike used is $\alpha\alpha\alpha$-trifluorotoluene.
SEO-020	TRH - Determination of Total Recoverable Hydrocarbons by gas chromatography following extraction with DCM/Acetone for solids and DCM for liquids.
SEI-001	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
SEI-010	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 20th ED, 1050-A, 1030-F.
SEI-017	Total Dissolved Solids - determined gravimetrically by drying the sample, in accordance with APHA 20th ED, 2540-C.

QUALITY CONTROL Metals in water (dissolved)	UNITS	PQL	METHOD	Blank
Arsenic	mg/L	0.005	Ext-018	[NT]
Cadmium	mg/L	0.0002	Ext-018	[NT]
Chromium	mg/L	0.005	Ext-018	[NT]
Copper	mg/L	0.001	Ext-018	[NT]
Lead	mg/L	0.001	Ext-018	[NT]
Nickel	mg/L	0.005	Ext-018	[NT]
Zinc	mg/L	0.005	Ext-018	[NT]
Mercury	mg/L	0.0001	Ext-018	[NT]

QUALITY CONTROL TRH/BTEX in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
TRH C_6 - C_9 P&T	mg/L	0.04	SEO-017	<0.040	Nil Rep.	Nil Rep.	Water	92
TRH C_{10} - C_{14}	mg/L	0.1	SEO-020	<0.10	Nil Rep.	Nil Rep.	Water	104
TRH C_{15} - C_{28}	mg/L	0.2	SEO-020	<0.20	Nil Rep.	Nil Rep.	Water	112
TRH C_{29} - C_{36}	mg/L	0.2	SEO-020	<0.20	Nil Rep.	Nil Rep.	Water	110
Benzene	mg/L	0.001	SEO-017	<0.001	Nil Rep.	Nil Rep.	Water	75
Toluene	mg/L	0.001	SEO-017	<0.001	Nil Rep.	Nil Rep.	Water	76
Ethylbenzene	mg/L	0.001	SEO-017	<0.001	Nil Rep.	Nil Rep.	Water	81
Total Xylenes	mg/L	0.003	SEO-017	<0.003	Nil Rep.	Nil Rep.	Water	78

QUALITY CONTROL Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD
pH	pH Units		SEI-001	[NT]	22262-1	Nil Rep.
Electrical Conductivity	µS/cm	1	SEI-010	<1.0	22262-1	4500 || 4500 || RPD: 0
Total Dissolved Solids	mg/L	5	SEI-017	<5	22262-1	Nil Rep.

QUALITY CONTROL Inorganics	UNITS	Dup. Sm#	Duplicate Base:Duplicate:% RPD
pH	pH Units	22262-2	Nil Rep.
Electrical Conductivity	µS/cm	22262-2	Nil Rep.
Total Dissolved Solids	mg/L	22262-2	11000 || 11000 || RPD: 0

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Registration
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

The methods detailed in this report have been validated. Analysis and QA/QC is in accordance with Schedule B(3) NEPM Guideline on Laboratory Analysis of Potentially Contaminated Soils - 1999.

Date Organics extraction commenced: 18/03/03

NATA Accreditation No. 4361

Quality Control Protocol

Reagent Blank: Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.

Matrix Spike Duplicates: Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.

Surrogate Spike: Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.

Internal Standard: Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.

Control Standards: Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity.

Additional QC Samples: A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.

25 May 2005 **TEST REPORT**

Douglas Partners Pty Ltd
96 Hermitage Road
WEST RYDE
NSW 2114

Your Reference: 37916, Rooty Hill
Report Number: 37656

Attention: Polo Foo

Dear Polo
The following samples were received from you on the date indicated.

Samples: Qty.	7 Soils
Date of Receipt of Samples:	24/05/05
Date of Receipt of Instructions:	24/05/05
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Sandra Taylor
Supervisor

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

		101	102	103	104	104
TRH/BTEX in Soil Our Reference: Your Reference Sample Type	UNITS ---------- ----------	37656-1 1/0.2-0.5 soil	37656-2 2/0.2-0.5 soil	37656-3 3/0.2-0.5 soil	37656-4 4/0.2-0.5 soil	37656-5 4/1.0-1.5 soil
TRH C_6 - C_9 P&T	mg/kg	<20	<20	<20	<20	<20
TRH C_{10} - C_{14}	mg/kg	<20	<20	<20	<20	<20
TRH C_{15} - C_{28}	mg/kg	<50	<50	<50	<50	<50
TRH C_{29} - C_{36}	mg/kg	<50	<50	<50	<50	<50
Benzene	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Toluene	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Ethylbenzene	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Total Xylenes	mg/kg	<1.5	<1.5	<1.5	<1.5	<1.5
Surrogate	%	88	84	82	78	74

		105	
TRH/BTEX in Soil Our Reference: Your Reference Sample Type	UNITS ---------- ----------	37656-6 5/0.2-0.5 soil	37656-7 Z2 soil
TRH C_6 - C_9 P&T	mg/kg	<20	<20
TRH C_{10} - C_{14}	mg/kg	<20	<20
TRH C_{15} - C_{28}	mg/kg	140	120
TRH C_{29} - C_{36}	mg/kg	260	130
Benzene	mg/kg	<0.50	<0.50
Toluene	mg/kg	<0.50	<0.50
Ethylbenzene	mg/kg	<0.50	<0.50
Total Xylenes	mg/kg	<1.5	<1.5
Surrogate	%	78	75

		101	102	103	104	104
Moisture						
Our Reference:	UNITS	37656-1	37656-2	37656-3	37656-4	37656-5
Your Reference	----------	1/0.2-0.5	2/0.2-0.5	3/0.2-0.5	4/0.2-0.5	4/1.0-1.5
Sample Type	----------	soil	soil	soil	soil	soil
Moisture	%	12	6.7	9.4	7.2	18

		105	
Moisture			
Our Reference:	UNITS	37656-6	37656-7
Your Reference	----------	5/0.2-0.5	Z2
Sample Type	----------	soil	soil
Moisture	%	14	20

Method ID	Methodology Summary
SEO-017	BTEX/TRH C6-C9 - Determination by Purge and Trap Gas Chromatography with Flame Ionisation Detection (FID) and Photo Ionisation Detection (PID). The surrogate spike used is aaa-trifluorotoluene.
SEO-020	TRH - Determination of Total Recoverable Hydrocarbons by gas chromatography following extraction with DCM/Acetone for solids and DCM for liquids.
SEP-001	Air Dry - Cover air drying at 40 C, moisture content at 103 C - 105 C, wet slurrying, compositing and preparation of a 1:5 soil suspension.

QUALITY CONTROL TRH/BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
TRH C_6 - C_9 P&T	mg/kg	20	SEO-017	<20	[NT]	[NT]	Batch	74 || 77 || RPD: 4
TRH C_{10} - C_{14}	mg/kg	20	SEO-020	<20	[NT]	[NT]	Batch	76 || 77 || RPD: 1
TRH C_{15} - C_{28}	mg/kg	50	SEO-020	<50	[NT]	[NT]	Batch	81 || 105 || RPD: 26
TRH C_{29} - C_{36}	mg/kg	50	SEO-020	<50	[NT]	[NT]	Batch	115 || 104 || RPD: 10
Benzene	mg/kg	0.5	SEO-017	<0.50	[NT]	[NT]	Batch	83 || 89 || RPD: 7
Toluene	mg/kg	0.5	SEO-017	<0.50	[NT]	[NT]	Batch	71 || 73 || RPD: 3
Ethylbenzene	mg/kg	0.5	SEO-017	<0.50	[NT]	[NT]	Batch	67 || 71 || RPD: 6
Total Xylenes	mg/kg	1.5	SEO-017	<1.5	[NT]	[NT]	Batch	89 || 90 || RPD: 1
Surrogate	%		SEO-017	[NT]	[NT]	[NT]	Batch	99 || 104 || RPD: 5

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Moisture	%		SEP-001	[NT]

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Accreditation
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

Date Organics extraction commenced: 24/05/05
NATA Corporate Accreditation No. 2562, Site No 4354
Note: Test results are not corrected for recovery (excluding Dioxins/Furans and PAH in XAD and PUF).

Quality Control Protocol

Reagent Blank: Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.
Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.
Matrix Spike Duplicates: Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.
Surrogate Spike: Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.
Internal Standard: Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.
Control Standards: Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity.
Additional QC Samples: A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.