Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Factual Report on Geotechnical Investigation

Centre of Excellence in Agricultural Education
Vines Drive, Richmond

Prepared for
NSW Department of Education

Project 202196.00
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
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Reviewer	pp GWM	17 May 2021

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Factual Report on Geotechnical Investigation
Centre of Excellence in Agricultural Education
Vines Drive, Richmond

1. Introduction

This factual report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for existing pavements at the Centre of Excellence in Agricultural Education, Vines Drive, Richmond. The investigation was commissioned in an email dated 17 March 2021 by Mr Alexander Phillips of Woolacotts Consulting Engineers Pty Ltd on behalf of the NSW Department of Education and was undertaken in accordance with DPs' proposal 202196.00 dated 26 February 2021.

It is understood that increased traffic loading is proposed along a 200 m section of Vines Drive and a 150 m section of Maintenance Lane and that construction of new pavements are proposed. Geotechnical investigation was carried out to provide information on the existing pavement profile for subsequent assessment by the civil consultant.

The investigation included the drilling of boreholes, Dynamic Cone Penetrometer (DCP) testing, and laboratory testing of selected samples. The details of the field work and laboratory testing are presented in this report, together with a summary of the subsurface conditions encountered.

2. Site Description

The pavements are at Vines Drive and Maintenance Lane, Richmond. The section along Vines Drive is approximately 200 m long and extends from the intersection with Maintenance Lane to the north-west. The section of Maintenance Lane extends for about 150 m to the south-east of the intersection with Vines Drive.

At the time of the field work, Vines Drive comprised an asphalt surfaced road with one lane marked in each direction. Maintenance Lane comprised an unmarked spray sealed road of about one and half lanes in width.

To the north-east and south-west of Vines Drive the surrounds typically comprise one and two storey buildings, landscaping, parking areas and grassed paddocks. To the north-west and south-east of Maintenance Lane are grassed paddocks, metal sheds and a parking area.

The site topography generally slopes to the south-east at gradients of less than 1°. The maximum elevation is at 23.7 m (AHD) at the north-western end of Vine Drive and the lowest elevation is at 22.8 m (AHD) at the south-western end of Maintenance Lane.

A location plan showing the approximate sections of new pavement is presented in Figure 1.

Figure 1: Site location plan showing approximate sections of new pavement (Source: MetroMap)

3. Published Data

3.1 Geology

Reference to the Penrith 1:100 000 scale Geological Series Sheet indicates that the site is underlain by Londonderry Clay of Tertiary age. The Londonderry Clay formation is typically 1 m to 9 m thick and typically consists of medium to high plasticity clays with ferruginous material and cemented sands with some localised areas of sand. Londonderry Clays are often underlain by Rickaby Creek Gravels, a basal gravel unit also of Tertiary Clay. The gravels are typically poorly sorted. The underlying bedrock at the site is expected to be either Bringelly Shale or Ashfield Shale of Triassic Age.

Field investigation confirmed the presence of sand on-site.

3.2 Hydrogeology

The closest surface water receptor to the site is a tributary of Rickabys Creek located about 290 m south-east of the intersection of Vines Drive and Maintenance Lane.

Based on the local topography, groundwater is anticipated to flow to the south-east towards Rickabys Creek.

A search of the NSW Department of Primary Industries Water (DPI Water) online map of registered groundwater works was undertaken as part of the investigation. The search carried out on 21 April 2021 identified no registered groundwater boreholes with groundwater information within 500 m of the site.

3.3 Acid Sulfate Soils

Review of published mapping indicates that the site is in an area of 'no known occurrence of acid sulfate soils'. The NSW Acid Sulfate Soils Manual 1998 published by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) indicates that ASS (and Potential Acid Sulfate Soils – PASS) normally occur in alluvial or estuarine soils below RL 5 m AHD although occasionally are encountered up to RL 12 m AHD. Considering the ASS mapping and given that the site soils are at site elevations above RL 20 m AHD, it is considered unlikely that ASS is present on-site.

3.4 Salinity

The Department of Infrastructure, Planning and Natural Resources (DIPNR) "Map of Salinity Potential in Western Sydney 2002" suggests that the site is in an area of "moderate salinity potential" with a higher potential in the lower elevations areas in close proximity to the Rickabys Creek system. Salinity investigation and testing was outside the agreed scope of this investigation.

4. Field Work

4.1 Methods

The field work included the following:

- Drilling of four boreholes (Bores 101 to 104) using a ute-mounted drilling rig with 110 mm diameter spiral flight augers. The boreholes were drilled to depths of 1.5 m.
- Four DCP tests carried out to 1.2 m depth or prior refusal in accordance with AS1289.6.3.2, to estimate the strength/relative density of the near-surface soils.

Disturbed samples were collected from the boreholes to assist with logging and for laboratory testing. The ground surface levels (measured in 'metres above Australian Height Datum AHD') together with the Eastings and Northings (measured to MGA94) at the borehole locations were determined by using a high precision Differential GPS which is accurate to approximately 0.1 m. The locations of the boreholes are shown on Drawing 1 in Appendix B.

4.2 Results

The borehole logs from the investigation are provided in Appendix C. Notes defining classification methods and terms used to describe the soils and rocks are included in Appendix A. The subsurface conditions encountered underlying the site can be summarised as follows:

- Pavement - asphaltic concrete 70 mm thick in Bores 101 and 102. Spray seal 10 mm thick in Bore 103 and spray seal 20 mm thick in Bore 104;
- Roadbase - sandy gravel basecourse to depths of between 0.13 m and 0.25 m in all boreholes;
- Natural Soil - medium dense to very dense sands in Bores 101 and 102 to depths of 1.5 m and loose to medium dense sands to depths of 1.5 m in Bores 103 and 104. Clayey sand bands were encountered within the sand profiles below depths of 1.2 m in Bores 102 and 103.

Water seepage was encountered below depths of between 0.7 m and 1.1 m in all boreholes during auger drilling. Backfilling of the boreholes following drilling precluded long-term monitoring of the water levels. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

5. Laboratory Testing

Selected samples from the boreholes were tested in the laboratory for measurement of moisture content, compaction properties and CBR. The detailed results are given in Appendix D and are summarised in Table 1.

Table 1: Results of Laboratory Testing

Sample Location	Material	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	CBR (%)
Bore 101	Sand	0.2 – 1.0	9.7	9.5	1.97	35
Bore 104	Sand	0.3 – 1.3	12.8	10.5	1.94	30

Notes:
FMC = Field Moisture Content
OMC = Standard Optimum Moisture Content
MDD = Maximum Dry Density
CBR = California bearing ratio

The CBR samples were compacted to approximately 100 % of standard maximum dry density at near optimum moisture content then soaked for four days under a 4.5 kg surcharge until tested. The CBR values were 35 % and 30 % for the sand samples tested, respectively. The samples were between 0.2 % and 2.3 % wet of Standard Optimum Moisture Content.

6. Comments

It is understood that civil consultant, Woolacotts Consulting Engineers Pty Ltd, will use the results obtained in this factual report as part of their pavement assessment. The interpretation and analysis of this report will be carried out by Woolacotts Consulting Engineers Pty Ltd. DP can assist in the interpretation of the results and design/construction options if required.

7. Limitations

Douglas Partners Pty Ltd (DP) has prepared this factual report for this project at Vines Drive, Richmond in accordance with DP's proposal dated 26 February 2021 and acceptance received from Mr Alexander Phillips of Woolacotts Consulting Engineers Pty Ltd on behalf of NSW Department of Education dated 17 March 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of NSW Department of Education and its agents for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Introduction

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

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

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

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

DATA FOR DESCRIPTION AND CLASSIFICATION OF SOILS – Page 1

Major Divisions				Description		Field Identification			
				Group Symbol*	Typical Name	Grading		Nature of Fines	Dry Strength
COARSE-GRAINED SOILS	More than 65% by dry mass, (excluding that larger than 63 mm) is greater than 0.075 mm	GRAVEL	More than 50% of coarse grains are greater than 2.36 mm	GW	Well graded gravels and gravel-sand mixtures, little or no fines.	Good	Wide range in grain size	'Clean' materials (not enough fines to bind grains)	None
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.	Poor	Predominantly one size or gap graded		
		GRAVELLY SOILS		GM	Silty gravels, gravel-sand-silt mixtures.	Good to Fair	'Dirty' materials with excess of fines	Fines are non-plastic	None to medium
				GC	Clay gravels, gravel-sand-clay mixtures.			Fines are plastic	Medium to high
		SAND	More than 50% of coarse grains are less than 2.36 mm	SW	Well graded sands and gravelly sands, little or no fines.	Good	Wide range in grain size	'Clean' materials (not enough fines to bind grains)	None
				SP	Poorly graded sands and gravelly sands, little or no fines.	Poor	Predominantly one size or gap graded		
		SANDY SOILS		SM	Silty sand, sand-silt mixtures.	Good to Fair	'Dirty' materials with excess of fines	Fines are non-plastic	None to medium
				SC	Clayey sands, sand-clay mixtures.			Fines are plastic	Medium to high
* For coarse grained soils where the fines content is between 5% and 12%, the soil shall be given a dual classification eg GP-GM.						Dry Strength		Dilatancy	Toughness
FINE-GRAINED SOILS	More than 35% by dry mass, (excluding that larger than 63 mm) is less than 0.075 mm	Liquid Limit less than 35%		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	None to low		Slow to rapid	Low
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high		None to slow	Medium
				OL	Organic silts and organic silty clays of low plasticity	Low to medium		Slow	Low
		35% <LL< 50%		CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high		None to slow	Medium
		Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.	Low to medium		None to slow	Low to medium
				CH	Inorganic clays of high plasticity, fat clays.	High to very high		None	High
				OH	Organic clays of medium to high plasticity.	Medium to high		None to very slow	Low to medium
				Pt	Peat muck and other highly organic soils.	Readily identified by colour, odour, spongy feel and generally fibrous texture			

ORDER OF DESCRIPTION

In the soil description the terms should be given in the following order:

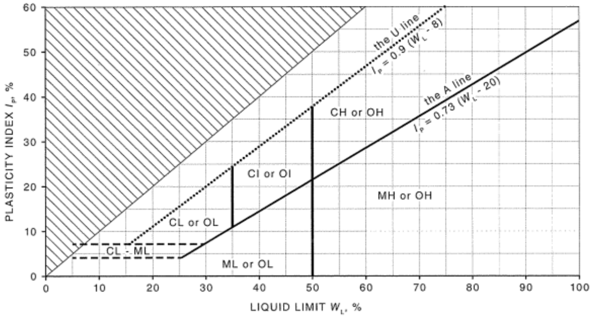
- SOIL NAME & UNIFIED CLASSIFICATION SYMBOL.
- Plasticity, behavioural or particle characteristics of the primary soil component
- Colour
- Secondary soil components' name(s), estimated proportion(s), plasticity, behavioural or particle characteristics, colour and where practical, its plasticity
- Moisture Condition (disturbed or undisturbed state)
- Consistency of fine-grained soils (undisturbed state only)
- Relative density of coarse-grained soils (determined by in situ tests)
- Structure of soil (in undisturbed state)
  - Zoning
  - Defects
  - Cementing
- Origin of soil
- Additional observations

EXAMPLES:

Silty SAND SM: fine to coarse grained, light brown, 15% non-plastic fines, with gravel, 20% angular particles, moist, apparently dense in place, alluvial.

SILT ML: low plasticity, brown, trace fine sand, w > PL, firm, estuarine.

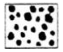
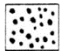
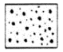
PLASTICITY CHART (after AS 1726:2017)



The classification system excludes the boulder and cobble fractions of the soil and classifies only the materials less than 63 mm in size.

PARTICLE SIZES

Boulders	> 200 mm
Cobbles	63 mm to 200 mm
Gravel	2.36 mm to 63 mm
Sand	0.075 mm to 2.36 mm
Silt and Clay	< 0.075 mm

SAND			SILT
COARSE 2.36-0.6 mm	MEDIUM 0.6-0.2 mm	FINE 0.2-0.075 mm	SILT 0.075-0.002 mm
			

Field Procedure Logging	Figure 4.1
Ed 9 / Rev 2	June 2019

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DATA FOR DESCRIPTION AND CLASSIFICATION OF SOILS – Page 2

GRAVEL

Density	Field Test
LOOSE	By inspection of voids and particle packing.
DENSE	

SAND

Density	Field Test	DPT Blows per 300 mm[(1)]		SPT N Blows	CPT q_c MPa	Relative Density %	Estimated Friction Angle
		Dry[(2)]	Wet[(3)]				
VERY LOOSE	Easily penetrated with 13 mm reinforcing rod pushed by hand.	< 1	0	0 – 4	0 – 2	0 – 15	25 - 30
LOOSE	Easily penetrated with 13 mm reinforcing rod pushed by hand. Can be excavated with a spade; 50 mm wooden peg can be easily driven.	1 - 3	< 1	4 – 10	2 – 5	15 – 35	27 - 32
MEDIUM DENSE	Penetrated 300 mm with 13 mm reinforcing rod driven by 2 kg hammer – hard shovelling.	3 - 8	1 - 6	10 – 30	5 – 15	35 – 65	30 - 35
DENSE	Penetrated 300 mm with 13 mm reinforcing rod driven with 2 kg hammer, requires pick for excavation; 50 mm wooden peg hard to drive	8 – 15	6 - 10	30 – 50	15 – 25	65 – 85	35 - 40
VERY DENSE	Penetrated only 25 – 50 mm with 13 mm reinforcing rod driven by 2 kg hammer.	> 15	> 10	> 50	> 25	85 – 100	38 - 43

[(1)]Valid for depths up to approx 1m bgl; [(2)]At a mc of approx. 3%-5%; [(3)]At a mc of approx. 15%.

SILT & CLAY

Consistency	Field Test		DCP Blows per 150 mm	SPT N Blows	Undrained Shear Strength C_u	Unconfined Compressive Strength q_u	CPT q_c kPa
					Shear Vane (kPa)	PP* (kPa)	
VERY SOFT	Easily penetrated > 40 mm by thumb. Exudes between thumb and fingers when squeezed in hand	Shear Vane Preferred	< 1	< 2	< 12	< 25	0 - 180
SOFT	Easily penetrated 10 mm by thumb. Moulded by light finger pressure.		1 – 1.5	2 – 4	12 – 25	25 – 50	180 - 375
FIRM	Impression by thumb with moderate effort. Moulded by strong finger pressure		1.5 – 3	4 – 8	25 – 50	50 – 100	375 - 750
STIFF	Slight impression by thumb cannot be moulded with finger		3 – 6	8 – 16	50 – 100	100 – 200	750 - 1500
VERY STIFF	Very tough. Readily indented by thumbnail.		6 – 12	16 – 32	100 – 200	200 – 400	1500 - 3000
HARD	Brittle. Indented with difficulty by thumbnail.		> 12	> 32	> 200	> 400	> 3000
FRIABLE	Easily crumbled or broken into small pieces by hand.						

* Pocket Penetrometer (**PP**) may overestimate q_u by a factor of 1.5 to 2.0.

Note: Visual-tactile assessment is indicative only. Use in-situ testing for logging

MOISTURE OF FINE GRAINED SOILS

Moist, dry of plastic limit	w < PL	Wet, near liquid limit	w ≈ LL
Moist, near plastic limit	w ≈ PL	Wet, wet of liquid limit	w > LL
Moist, wet of plastic limit	w > PL		

DEGREE OF SATURATION OF SANDS

Condition of Sand	Criteria	Degree of Saturation (%)
Dry	Non-cohesive and free-running	0 – 25%
Moist	Feels cool, darker colour, grains tend to adhere to one another	25 – 75%
Wet	Feels cold, makes hands wet, should be close to water table	75 – 99%

FIELD IDENTIFICATION PROCEDURE FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus 0.4 mm sieve size particles. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):

After removing particles larger than 0.4 mm sieve size, prepare a pat of moist soil with a volume of about 8000 mm^3. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil. Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):

After removing particles larger than 0.4 mm sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same dry strength but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):

After removing particles larger than the 0.4 mm sieve size, a specimen of soil about 12 mm cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about 3 mm in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced, and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached. After the thread crumbles, the pieces should be lumped together, and a slight kneading action continued until the lump crumbles.

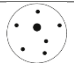
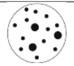
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay or low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

PROPORTION OF MINOR AND SECONDARY COMPONENTS

Term	Meaning	Approximate Proportion	
		Coarse Soils	Fine Soils
Trace	Just detectable by feel or eye. Soil properties of main component virtually unaffected.	< 5% fines < 15 % coarse fraction	< 15% sand / gravel
With	Easily detectable by feel or eye. Soil properties only slightly affected by minor components.	5% – 12% fines 15% – 30% coarse fraction	15% – 30% sand / gravel
Prefix	Easily detected by feel or eye. Soil properties significantly affected by secondary components.	> 12% fines > 30% coarse fraction	> 30% sand / gravel

PROPORTIONS OF SECONDARY COMPONENTS

5%	12%	35%
		

DATA FOR DESCRIPTION AND CLASSIFICATION OF ROCK

SEDIMENTARY ROCK TYPE DEFINITIONS

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 mm 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, e.g. Clayey SANDSTONE, Sandy SHALE.

DEGREE OF WEATHERING

Term	Abbreviation	Definition
Residual soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure, material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	HW DW*	The whole of the rock is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
Moderately Weathered	MW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.
Slightly Weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition of individual minerals or colour changes.

*If highly and moderately weathered rock cannot be differentiated use the term, 'Distinctly Weathered (DW)'.

ORDER OF DESCRIPTION

In the rock description the terms should be given in the following order:
ROCK NAME
Grain size and type
Colour
Fabric and texture
Inclusions and minor components
Moisture content
Durability
Strength
Weathering and/or alteration
Defects – type, orientation, spacing, roughness
Stratigraphic unit
Geological structure

STRATIFICATION

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 discontinuous. These include bedding plane partings, joints and other rock defects, **but exclude artificial fractures such as drilling breaks.**

Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter
Highly Fractured	Core lengths are generally less than 20 mm to 40 mm with occasional fragments
Fractured	Core lengths are mainly 30 mm to 100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths are generally 300 mm or longer with occasional sections of 100 mm to 300 mm
Unbroken	The core contains very few fractures

ROCK STRENGTH

Rock strength is classified using the unconfined compressive strength (UCS). Where adequate UCS data are not available then the classification may be based on the Point Load Strength ($I_{s(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding.

Strength Term	UCS MPa	Field Guide	Approx $I_{S(50)}$ MPa
Material less than very low strength is to be described using soil properties			
Very Low	2	Material crumbles under firm blows with sharp end of pick; can be peeled with knife. Pieces up to 30 mm thick can be broken by finger pressure.	0.1
Low	6	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 by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.3
Medium	20	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	1.0
High	60	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	3.0
Very High	200	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	10.0
Extremely High		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	

The approximate point load strength ($I_{S(50)}$) is based on an assumed ratio to UCS of 1:20. This ratio may vary widely and should be determined for each site and rock type.

DISCONTINUITIES / DEFECTS

The actual defect is described not the process which formed or may have formed it, e.g. 'sheared zone', not 'zone of shearing'; the latter suggests a currently active process.

Spacing*:

A measure of the spacing of discontinuities. Measure mean and range of spacings for each set where possible (do not use descriptive terms).

Thickness, openness:

Measured in millimetres normal to plane of the discontinuity.

Persistence*:

The areal extent of a discontinuity. Give trace lengths in metres.

Roughness and Shape*:

A measure of the inherent surface unevenness and waviness of the defect relative to its mean plane.

Coating or Infilling:

Clean: no visible coating or infilling.

Stained: no visible coating or infilling but surfaces are discoloured by mineral staining.

Veneer: a visible coating or infilling of soil or mineral substance but usually unable to be measured (less than 1 mm).

Patchy Veneer: if discontinuous over the plane.

Coating: a visible coating or infilling of soil or mineral substance, greater than 1 mm thick. Describe composition and thickness.

* Usually determined in field exposures

Roughness:

- Very Rough
- Rough
- Smooth
- Polished
- Slickensided

Shape*:

- Planar
- Curved
- Undulating
- Stepped
- Irregular

Discontinuity Spacing in Three Dimensions:

The spacing of discontinuities in exposures may be described with reference to the size and shape of rock bounded by the discontinuities.

Equidimensional	Same size in all directions
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section
Polyhedral	Irregular defects without obvious pattern

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

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

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

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

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:
  4,6,7
  N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:
  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Symbols & Abbreviations

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Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General

■	Asphalt
▒	Road base
△	Concrete
▩	Filling

Soils

▒	Topsoil
✱	Peat
▨	Clay
▨	Silty clay
▨	Sandy clay
▨	Gravelly clay
▨	Shaly clay
▥	Silt
▥	Clayey silt
▥	Sandy silt
░	Sand
░	Clayey sand
░	Silty sand
○	Gravel
○	Sandy gravel
◯	Cobbles, boulders
△	Talus

Sedimentary Rocks

◯	Boulder conglomerate
◯	Conglomerate
░	Conglomeratic sandstone
░	Sandstone
▤	Siltstone
▤	Laminite
▤	Mudstone, claystone, shale
■	Coal
▦	Limestone

Metamorphic Rocks

~	Slate, phyllite, schist
+	Gneiss
·	Quartzite

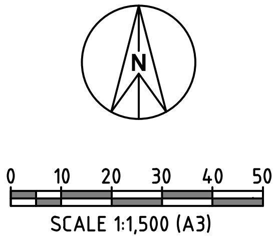
Igneous Rocks

+	Granite
‹	Dolerite, basalt, andesite
×	Dacite, epidote
∨	Tuff, breccia
▷	Porphyry

Appendix B

Drawing No 1

Location Plan



LEGEND:-

⌖ Borehole Location and Number

NOTE:-

1. Test locations are approximate only and are shown with reference to existing site features.
2. Image obtained from Metromap. Date of imagery 10-12-2020.

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CLIENT: NSW Department of Education		TITLE: **Site and Test Location Plan** **Centre of Excellence in Agricultural Education** **Vines Drive, Richmond**	PROJECT No: 202196.00
OFFICE: North West Sydney	DRAWN BY: JST		DRAWING No: 1
SCALE: As shown	DATE: 21 April 2021		REVISION: 0

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Appendix C

Results of Field Work

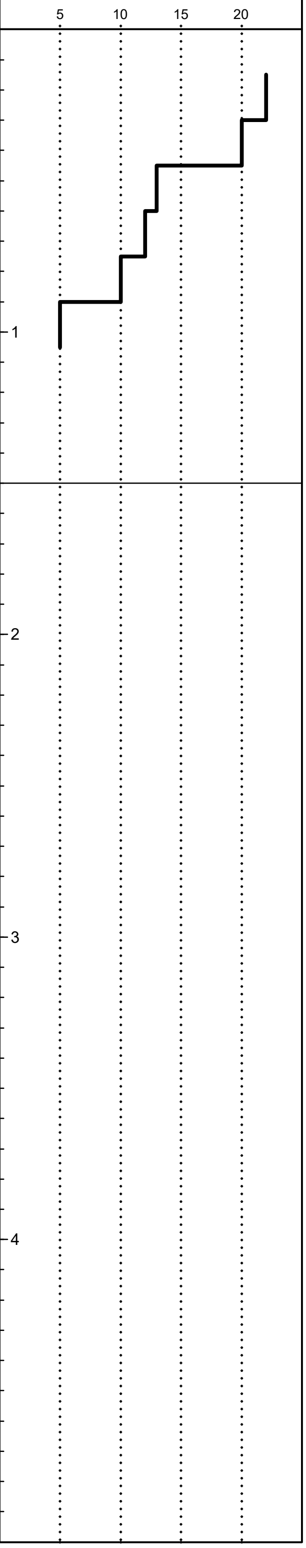
BOREHOLE LOG

CLIENT: Woolacotts Consulting Engineers Pty Ltd
PROJECT: Centre of Excellence in Agricultural Education
LOCATION: Vines Drive, Richmond

SURFACE LEVEL: 23.4 mAHD
EASTING: 291036.6
NORTHING: 6278244.6
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 202196.00
DATE: 19/4/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.07	ASPHALTIC CONCRETE		A	0.07 0.13				
	0.13	FILL/ROADBASE: Sandy Gravel GM: 20mm, grey, fine to medium, dry, igneous gravel (basecourse)		A	0.2 0.3				
23		SAND SP: medium to coarse-grained, brown, moist, dense to very dense, alluvial - becoming grey from 0.4m - becoming dense from 0.5m - becoming medium-dense from 0.9m		B	1.0				
	1.0	SAND SP: medium to coarse grained, brown, moist, medium dense, alluvial - water seepage, sand saturated from 1.1m							
22	1.5	Bore discontinued at 1.5m - Limit of investigation							
21	2								
20	3								
19	4								



RIG: Christie **DRILLER:** Nepean **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm Diameter SFA
WATER OBSERVATIONS: Water seepage from 1.1m
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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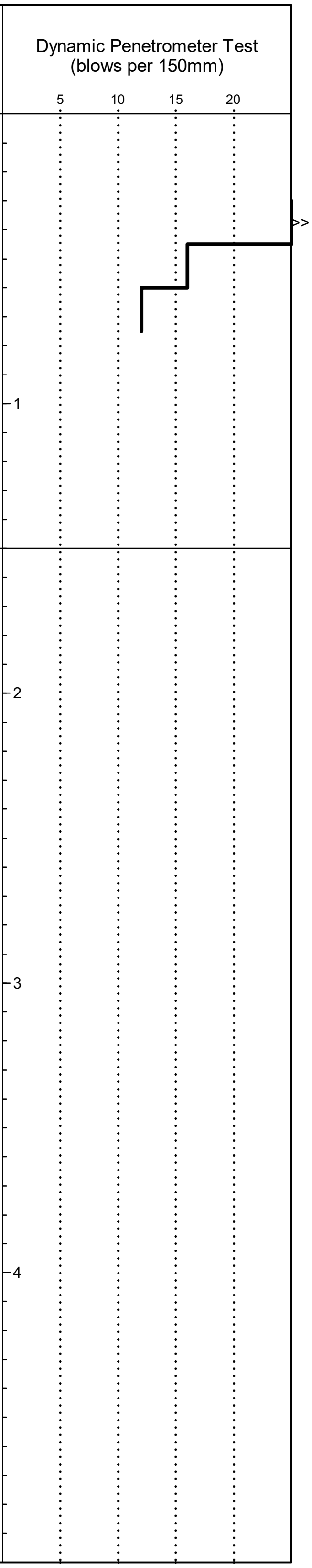
BOREHOLE LOG

CLIENT: Woolacotts Consulting Engineers Pty Ltd
PROJECT: Centre of Excellence in Agricultural Education
LOCATION: Vines Drive, Richmond

SURFACE LEVEL: 23.1 mAHD
EASTING: 291125.8
NORTHING: 6278163.5
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 202196.00
DATE: 19/4/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.07	ASPHALTIC CONCRETE		A	0.07 0.13			
	0.13	FILL/ROADBASE: Sandy Gravel GM: 20mm, grey, fine to medium, dry, igneous gravel (basecourse)		A	0.2 0.3			
		SAND SP: medium grained, brown and grey, moist, dense to very dense, alluvial - water seepage from 1.1m - with clayey sand bands from 1.2m						
	1.5	Bore discontinued at 1.5m - Limit of investigation						



RIG: Christie **DRILLER:** Nepean **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm Diameter SFA
WATER OBSERVATIONS: Water seepage from 1.1m
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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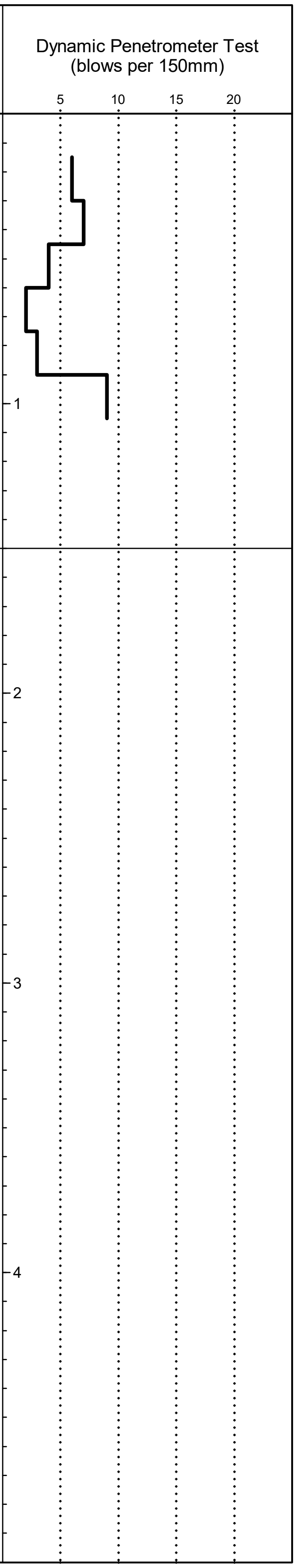
BOREHOLE LOG

CLIENT: Woolacotts Consulting Engineers Pty Ltd
PROJECT: Centre of Excellence in Agricultural Education
LOCATION: Vines Drive, Richmond

SURFACE LEVEL: 22.8 mAHD
EASTING: 291067.5
NORTHING: 6277972.9
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 202196.00
DATE: 19/4/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.01	SPRAYED SEAL						
	0.15	FILL/ROADBASE: Sandy GRAVEL GM: 20mm, fine to medium, dry, igneous gravel (basecourse)		A	0.1 0.15			
		SAND SP: medium grained, brown, moist, loose to medium dense, alluvial		A	0.2 0.3			
22								
	1	- becoming pale grey and saturated from 1.0m						
		- with orange, clayey sand bands from 1.2m		A	1.2 1.3			
	1.5	Bore discontinued at 1.5m						
21	2							
20	3							
19	4							
18								



RIG: Christie **DRILLER:** Nepean **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm Diameter SFA
WATER OBSERVATIONS: Water seepage from 1.0m
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

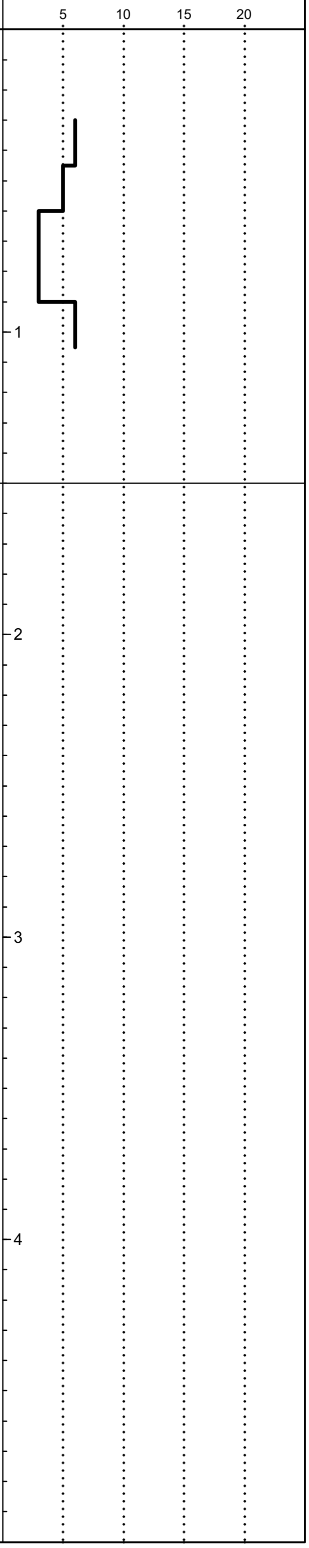
CLIENT: Woolacotts Consulting Engineers Pty Ltd
PROJECT: Centre of Excellence in Agricultural Education
LOCATION: Vines Drive, Richmond

SURFACE LEVEL: 22.8 mAHD
EASTING: 291126.22
NORTHING: 6278036.1
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 202196.00
DATE: 19/4/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.02	SPRAYED SEAL						
	0.25	FILL/ROADBASE: Sandy GRAVEL GM: 20mm, grey, fine to medium, dry, igneous gravel (basecourse)		A	0.1 0.2			
		SAND SP: medium grained, brown, moist, loose to medium dense, alluvial			0.3			
				A	0.5 0.6			
22		- water seepage, becoming saturated and pale grey from 0.7m		B	0.6 1.3			
	1.5	Bore discontinued at 1.5m						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Christie **DRILLER:** Nepean **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm Diameter SFA
WATER OBSERVATIONS: Water seepage from 0.7m
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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Appendix D

Laboratory Test Results

Material Test Report

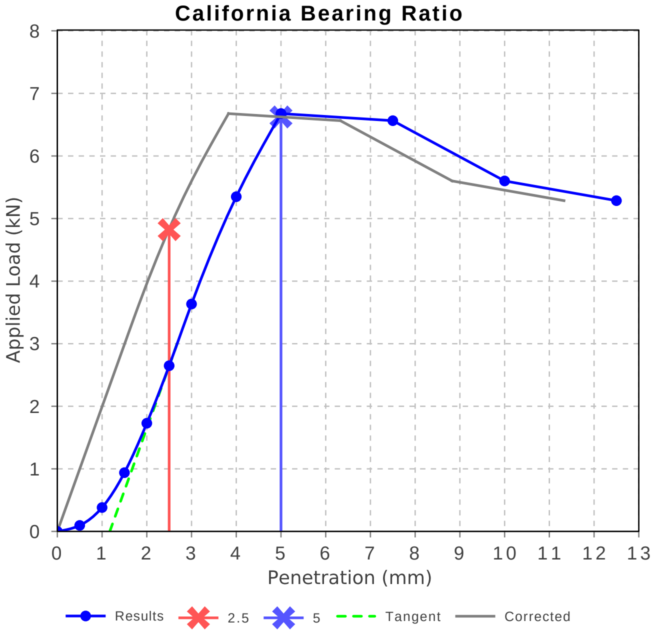
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

Report Number: **202196.00-1**
Issue Number: 1
Date Issued: 07/05/2021
Client: NSW Department of Education
Level 5 NSW, 2000, Sydney NSW 2000
Contact: Alex Phillips
Project Number: 202196.00
Project Name: Centre of Excellence in Agricultural Education
Project Location: Vines Drive, Richmond
Work Request: 7699
Sample Number: SY-7699A
Date Sampled: 19/04/2021
Dates Tested: 20/04/2021 - 04/05/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH101 , Depth: 0.2-1.0m**
Material: SAND: brown grey

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**35.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.97		
Optimum Moisture Content (%)	9.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	104.0		
Dry Density after Soaking (t/m^3)	1.96		
Field Moisture Content (%)	9.7		
Moisture Content at Placement (%)	9.9		
Moisture Content Top 30mm (%)	11.2		
Moisture Content Rest of Sample (%)	10.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

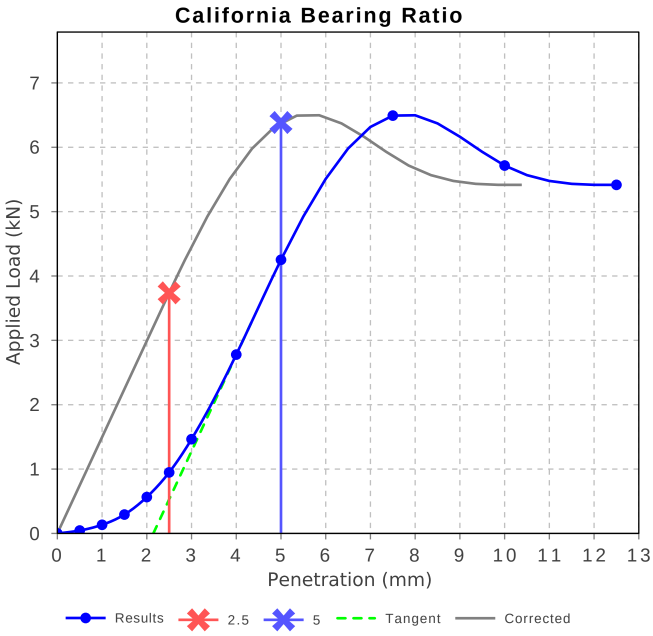
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202196.00-1**
Issue Number: 1
Date Issued: 07/05/2021
Client: NSW Department of Education
Level 5 NSW, 2000, Sydney NSW 2000
Contact: Alex Phillips
Project Number: 202196.00
Project Name: Centre of Excellence in Agricultural Education
Project Location: Vines Drive, Richmond
Work Request: 7699
Sample Number: SY-7699B
Date Sampled: 19/04/2021
Dates Tested: 20/04/2021 - 04/05/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH104 , Depth: 0.3-1.3m**
Material: SAND: brown grey

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**30.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.94		
Optimum Moisture Content (%)	10.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.95		
Field Moisture Content (%)	12.8		
Moisture Content at Placement (%)	10.5		
Moisture Content Top 30mm (%)	12.9		
Moisture Content Rest of Sample (%)	11.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	0.1		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number:	**202196.00-1**
Issue Number:	1
Date Issued:	07/05/2021
Client:	NSW Department of Education Level 5 NSW, 2000, Sydney NSW 2000
Contact:	Alex Phillips
Project Number:	202196.00
Project Name:	Centre of Excellence in Agricultural Education
Project Location:	Vines Drive, Richmond
Work Request:	7699
Dates Tested:	20/04/2021 - 30/04/2021
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
Laboratory Accreditation Number: 828

Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Material
SY-7699A	BH101 , Depth: 0.2-1.0m	9.7 %	SAND: brown grey
SY-7699B	BH104 , Depth: 0.3-1.3m	12.8 %	SAND: brown grey