

Table of Contents

1. INTRODUCTION	1
2. SITE DETAILS	1
2.1 SITE DESCRIPTION	2
2.2 GEOLOGY	2
2.3 PROPOSED DEVELOPMENT	2
3. GEOTECHNICAL INVESTIGATION	2
3.1 SUBSURFACE PROFILES	3
3.2 LABORATORY TEST RESULTS	3
4. RECOMMENDATIONS	4
4.1 SITE PREPARATION.....	4
4.2 EARTHWORKS / FILL SPECIFICATION	5
4.3 PAVEMENT DESIGN PARAMETERS	5
5. CONDITIONS OF THE RECOMMENDATIONS	5
6. LIMITATIONS	6

TABLES

TABLE 1: SUMMARY OF SITE DETAILS	1
TABLE 2: GENERALISED SUMMARY OF GEOLOGICAL UNITS	3
TABLE 3: DEPTH OF EACH GEOLOGICAL UNIT	3
TABLE 4: SUMMARY OF LABORATORY TEST RESULTS FOR SOIL PROPERTIES	3
TABLE 5: SUMMARY OF EARTHWORKS SPECIFICATIONS	5

APPENDICES

APPENDIX A

BOREHOLE LOGS

APPENDIX B

DYNAMIC CONE PENETROMETER (DCP) TEST RESULTS

APPENDIX C

LABORATORY TEST CERTIFICATES

1. INTRODUCTION

Ground Technologies Pty Ltd (Ground Tech) has prepared this report to discuss the results of the geotechnical investigation for the proposed development at Norman Griffiths Oval, West Pymble (herein referred to as the "site"). Ground Tech was engaged to provide professional assistance for this component of the project.

The geotechnical investigation included drilling nine boreholes using our 4WD Toyota Landcruiser Drill Rig to determine the subsoil profile and undertaking nine Dynamic Cone Penetrometer (DCP) tests in order to assess their in-situ strength. Two representative soil samples were collected and sent to the Ground Technologies NATA accredited laboratory to determine the Atterberg limits and Particle Size Distribution and CBR value of the underlying soil profile. This report provides a geotechnical assessment on the existing soil and rock conditions.

This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site or to the construction method.

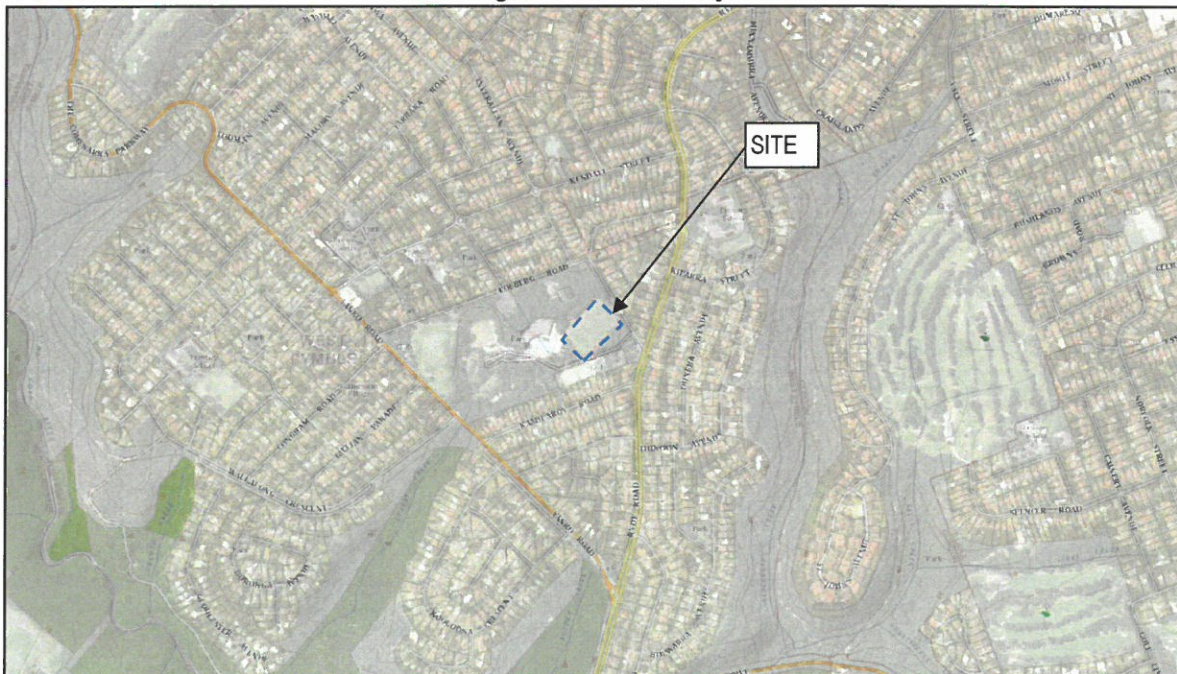
2. SITE DETAILS

The following information, presented in Table 1, describes the site.

Table 1: Summary of Site Details

Site Address	Norman Griffiths Oval, West Pymble
Owner / Developer	Northern Suburbs Football Association
Council Area	Ku-ring-gai Council

Figure 2.1 Site Locality



2.1 SITE DESCRIPTION

The site is a single rectangular sport field at the intersection of Lofberg Road and Prince of Wales drive in West Pymble, within the Heffron Park complex. The sports field is currently grassed, bounded on all four sides by wooded parkland area. A small two storey building is located just outside the northern boundary of the sports field.

Gradients within the sports field are flat. Gradients north of the sports field rise gently up a small hill.

A buried stormwater drain extends across the site in a south-east to north-west direction. From site observations and borehole data it is inferred that a creek alignment formerly passed through the center of the sports field. The creek area appears to have been filled, and a cut taken from the hillside on the northern side, to form the existing flat surface.

2.2 GEOLOGY

The 1:100,000 scale Geological Series Map of the Sydney region indicates that the subject site is underlain by Hawkesbury Sandstone of the Wianamatta Group dating back to the Middle Triassic period and generally comprise *medium to coarse grained Quartz Sandstone, and very minor Shale and Laminite lenses*. The map also indicates an area underlain by Shale, within 50m of the eastern boundary of the site.

2.3 PROPOSED DEVELOPMENT

It is understood the proposed development comprises a sports field with synthetic turf pavement.

3. GEOTECHNICAL INVESTIGATION

Fieldwork was undertaken on 11th of September 2015 and comprised drilling nine boreholes using our 4WD Toyota Landcruiser Drill Rig and nine DCP tests adjacent to the boreholes, at the locations indicated on Figure 3.1. All test sites were located in the vicinity of the proposed development. Geotechnical Borehole data is presented in Appendix A and the DCP test results are presented in Appendix B.

Figure 3.1 Test Locations



3.1 SUBSURFACE PROFILES

A number of distinct geological units were encountered during the field investigation. A generalised description and summary of encountered depths is provided in Tables 2 and 3. Detailed borehole logs are provided in Appendix A.

Table 2: Generalised Summary of Geological Units

UNIT	SOIL TYPE
Unit A	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
Unit B	FILL; Admixed Sandy/Gravelly CLAY, red, brown, pale brown, with silt, slightly moist, very moist at some locations. Appears compacted.
Unit C	NATURAL (Alluvium); Silty CLAY, medium plasticity, dark brown and grey, very moist to wet, firm to stiff.
Unit D	NATURAL; Silty CLAY, medium plasticity, yellow-brown, moist, stiff to very stiff, or Clayey SAND, medium dense.
Unit E	BEDROCK; SANDSTONE, extremely to highly weathered, white and yellow-brown, extremely low to very low strength.

Table 3: Depth of each Geological Unit

UNIT	BOREHOLE INTERCEPT DEPTHS (m)								
	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9
Unit A	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	-	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Unit B	0.2-2.0	0.2-2.0	0.5-1.0	0.2-1.3	0.0-0.3	-	-	0.2-1.0	0.2-1.7
Unit C	-	2.0-2.8	-	1.3-1.6		0.2-1.2	0.2-0.5		-
Unit D	-	-	1.0-1.5	-		-	-	1.0-1.5	1.7-2.0
Unit E	2.0-2.2	-	-	-	0.3-0.6	1.2-1.5	0.5-1.0		-

3.2 LABORATORY TEST RESULTS

Two (2) soil samples were recovered for soil material parameter testing during the course of the field investigation. These samples were submitted to Ground Technologies NATA accredited laboratory in order to determine the Particle Size Distribution and Plasticity Index of the underlying soil profile. The results are summarized in table 4 below whilst the full reports are contained within Appendix C.

Table 4: Summary of Laboratory Test Results for Soil Properties

Sample ID	BH	Depth	Geological Unit	Plastic Index	Particle Size Distribution			CBR
					Gravel	Sand	Silt / Clay	
L1	BH2	0.2-1.1m	Unit B	24	12	38	50	4.5
L2	BH6	0.2-1.0m	Unit C	35	2	32	66	6.0

4. RECOMMENDATIONS

4.1 SITE PREPARATION

Subsurface ground conditions at the site are considered suitable for construction of the proposed synthetic turf sports field subject to the site being prepared as detailed below.

Fill was encountered at the site, which appears relatively compacted based on drilling rates and DCP testing data. However, no compaction certificates were available at the time of preparing this report and as such this material is classed as "Uncontrolled" fill. Should compaction certificates become available, this office should be informed and the recommendations made in this report amended.

As the fill is uncontrolled and of varying thicknesses and composition, the risk of settlements and differential settlements within the filled area resulting in damage to the synthetic surface or drainage system, should be noted. In order to control the above mentioned risk, the following recommendations should be adopted:

- Strip the top soil (Unit A) from the ground surface.
- Conduct a stripped site inspection and proof roll in order to identify any unsuitable material within the subgrade profile.
- Excavate zones of unsuitable material
- Impact roll the exposed subgrade until incremental settlements are no greater than 5mm for each 5 passes.
- Bring the impact rolled surface to design subgrade levels with engineered fill. See notes on Engineered Fill in Section 4.2.

Impact rollers can successfully compact loose soils up to 3 metres in depth. By travelling at speeds of up to 15 km/hr, large areas can be effectively and efficiently densified. The number of passes required to achieve densification depends on the type of material being densified, the degree of initial compaction and the moisture content. Experience suggests that after about 20 to 25 passes there is usually no significant measurable settlement due to further impact rolling.

Impact rolling also induces vibrations. Experience suggest for structures 50 metres from the area being treated could experience peak particle velocities less than 5 mm/sec. Peak particle velocity, of up to 10 mm/sec do not normally cause damage to residential buildings. Vibration monitoring at the commencement of the impact rolling should be undertaken to ensure these limits are not exceeded on any relevant structures. It should also be noted that impact rolling will destroy any existing shallow services present, such as drainage or irrigation pipes.

4.2 EARTHWORKS / FILL SPECIFICATION

Subgrade replacement is to occur after the underlying fill material has been impact rolled. Fill placement shall be in near horizontal layers of uniform thickness placed systematically across the fill area. The compacted layer thickness is not to exceed 300mm with a maximum particle size not to exceed 2/3rd of layer thickness.

Testing is to be undertaken as per the Level 2 requirements of AS3798 – 2007 'Guidelines on Earthworks for Commercial and Residential Development'.

Table 5: Summary of Earthworks Specifications

DESCRIPTION	SPECIFICATION
Dry or Hilf Density Ratio	95% Standard Compaction
Moisture Variation	+/- 2% OMC
Frequency of Testing	1/500m ³ or 3 tests per lot, whichever is greater.

Materials not suitable for Engineered Fill include;

- Organic soils, such as many topsoils, severely root-affected subsoils and peat
- Materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture
- Silts, or materials that have deleterious engineering properties of silt
- Other materials with properties that are unsuitable for forming structural fill
- Fill which contains wood, metal, plastic, boulders(over 200mm in size) or other deleterious materials

4.3 PAVEMENT DESIGN PARAMETERS

Pavement design can be based on a California Bearing Ratio (C.B.R) value of 4.5%. This value assumes that drainage is suitably detailed to prevent any saturation of sub-grade or pavement materials.

5. CONDITIONS OF THE RECOMMENDATIONS

The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the site may differ from those found in the test holes. If excavations reveal subsurface conditions significantly different from those shown in our attached Soil/Rock Log(s), Ground Tech must be consulted and excavations stopped immediately.

The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. The description of the foundation material for has been provided for its easy recognition over the whole site.

Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building. Dimensions on logs are correct.

6. LIMITATIONS

This type of investigation (as per our commission) is not designed or capable of locating all ground conditions, (which can vary even over short distances). The advice given in this report is based on the assumption that the test results are representative of the overall ground conditions. However, it should be noted that actual conditions in some parts of the site might differ from those found. If further sampling reveals ground conditions significantly different from those shown in our findings, Ground Tech must be consulted.

The scope and the period of Ground Tech services are described in the report and are subject to restrictions and limitations. Ground Tech did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ground Tech in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ground Tech for incomplete or inaccurate data supplied by others.

Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning. This document is COPYRIGHT- all rights reserved. No part of this document may be reproduced or copied in any form or by means without written permission by Ground Technologies Pty Ltd. All other property in this submission shall not pass until all fees for preparation have been settled. This submission is for the use only of the party to whom it is addressed and for no other purpose. No responsibility is accepted to any third party who may use or rely on the whole or any part of the content of this submission. No responsibility will be taken for this report if it is altered in any way, or not reproduced in full. This document remains the property of Ground Technologies Pty Ltd until all fees and monies have been paid in full.

APPENDIX A

Borehole Logs

BH1

Depth (m)	Soil Profile
0.0 - 0.20	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.20 - 1.0	FILL; Admixed CLAY, red-brown, grey, with some fine gravel, slightly moist, appears well compacted.
1.0 - 2.0	As above, becoming very moist.
2.0 - 2.2	BEDROCK; SANDSTONE, extremely to highly weathered, white and yellow-brown, extremely low to very low strength.

BH2

Depth (m)	Soil Profile
0.0 - 0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2 - 2.0	FILL; Admixed Sandy/Gravelly CLAY, yellow, brown, pale-brown, moist.
2.0 - 2.8	NATURAL (Alluvium); Silty CLAY, medium plasticity, dark brown and grey, very moist to wet, firm.

BH3

Depth (m)	Soil Profile
0.0 - 0.5	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.5 - 1.0	FILL; Admixed CLAY, red-brown, grey, with some fine gravel, slightly moist, appears well compacted.
1.0 - 1.5	NATURAL Silty CLAY, medium plasticity, yellow-brown, moist, very stiff.

BH4

Depth (m)	Soil Profile
0.0 - 0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2 - 1.3	FILL; Admixed Sandy/Gravelly CLAY, red, brown, pale brown, with silt, slightly moist.
1.3 - 1.6	NATURAL (Alluvium); Silty CLAY, medium plasticity, dark brown and grey, very moist, firm to stiff.

BH5

Depth (m)	Soil Profile
0.0 – 0.3	FILL; Admixed Sandy/Gravelly CLAY, red, brown, pale brown, with silt, slightly moist.
0.3 – 0.6	BEDROCK; SANDSTONE, extremely to highly weathered, white and yellow-brown, extremely low to very low strength.

BH6

Depth (m)	Soil Profile
0.0 – 0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2 – 1.2	NATURAL Silty CLAY, medium plasticity, yellow-brown, moist, stiff to very stiff.
1.2 – 1.5	BEDROCK; SANDSTONE, extremely to highly weathered, white and yellow-brown, extremely low to very low strength.

BH7

Depth (m)	Soil Profile
0.0 – 0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2 – 0.5	NATURAL; SAND, fine to medium grained, yellow-brown, medium dense.
0.5 – 1.0	BEDROCK; SANDSTONE, extremely to highly weathered, white and yellow-brown, extremely low to very low strength.

BH8

Depth (m)	Soil Profile
0.0-0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2-1.0	FILL; Admixed Sandy/Gravelly CLAY, red, brown, pale brown, with silt, slightly moist.
1.0 – 1.5	NATURAL; Clayey SAND, fine to medium grained, white, pale yellow, medium dense.

BH9

Depth (m)	Soil Profile
0.0 – 0.2	TOPSOIL; SAND, fine to medium grained, brown, with some silt, moist.
0.2 – 1.7	FILL; Admixed Sandy/Gravelly CLAY, red, brown, pale brown, with silt, slightly moist.
1.7 – 2.0	NATURAL (Alluvium); Silty CLAY, medium plasticity, dark brown and grey, very moist to wet, firm.

APPENDIX B

Dynamic Cone Penetrometer (DCP) Test Results

Test No:	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9
Start	Existing surface								
Depth (m)	Number of blows per 100mm, Test Method AS 1289.6.3.3, Cone tip, 510mm Drop								
0.0 – 0.1	5	5	6	3	4	4	4	4	8
0.1 – 0.2	10	9	8	6	PR/HR	5	7	6	5
0.2 – 0.3	10	9	6	6		12	11	6	5
0.3 – 0.4	8	8	5	8		13	6	18	3
0.4 – 0.5	7	6	3	8		9	10	9	5
0.5 – 0.6	5	4	4	3		7	PR/HR	11	3
0.6 – 0.7	9	4	5	2		5		10	5
0.7 – 0.8	5	5	4	2		5		5	4
0.8 – 0.9	4	4	4	1		4		3	5
0.9 – 1.0	5	3	7	2		5		2	6
1.0 – 1.1	4	4	5	1		PR		3	4
1.1 – 1.2	3	5	8	2				4	9
1.2 – 1.3	3	5	11	2				4	24
1.3 – 1.4	5	6	9	2				3	PR
1.4 – 1.5	4	4	6	3				4	
1.5 – 1.6	4	4	9	3				4	
1.6 – 1.7	6	4	6	3				6	
1.7 – 1.8	6	4	6	4					
1.8 – 1.9									
1.9 – 2.0									

PR: Practical refusal, HR: Hard refusal

APPENDIX C

Laboratory Test Certificates

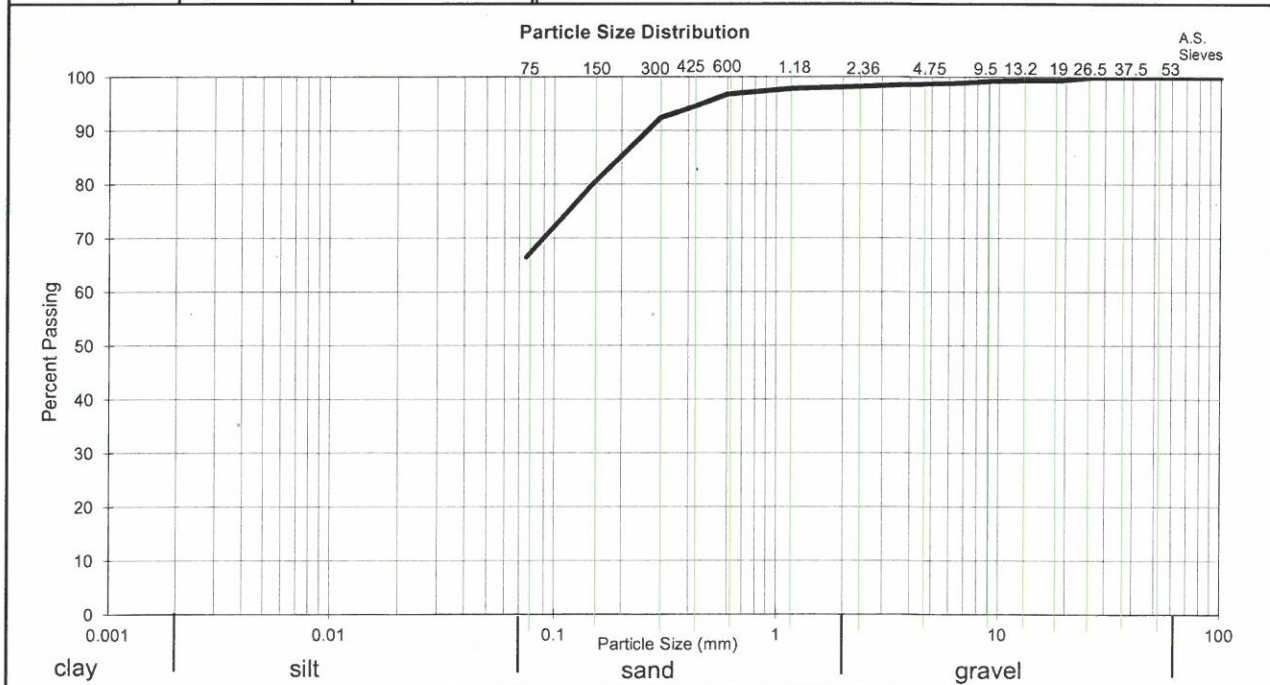
Geotechnical Testing Services

Particle Size Distribution & Atterberg Limits Test Report

Client:	Northen Suburbs Football Association	Job No.	GTE634
Project:	Norman Griffiths Oval	Test Date:	11-Sep-15
Location:	Norman Griffiths Oval , West Pymble	Report No.	GTER634-L3
Lab Reference No.	L2	Sample Location:	BH06 0.2 - 1.0m

Laboratory Specimen Classification: Mottled Red/Brown Sandy Clay

Particle Size Distribution AS1289 3.6.1			Consistency Limits and Moisture Content			
Sieve Size	% Passing	Specification	Test	Method	Result	Spec.
150 mm	100		Liquid Limit	% AS1289 3.1.2	55	
75 mm	100		Plastic Limit	% AS1289 3.2.1	20	
53 mm	100		Plasticity Index	% AS1289 3.3.1	35	
37.5 mm	100		Linear Shrinkage	% AS1289 3.4.1	ND	
26.5 mm	100		Moisture Content	% AS1289 2.1.1	22.8	
19.0 mm	99		Sample History: Oven Dried			
13.2 mm	99		Preparation Method: Dry sieved			
9.5 mm	99		Crumbling / Curling of linear shrinkage:			
6.7 mm	99		Linear shrinkage mould length: 250 mm			
4.75 mm	99		ND = not determined NO = not obtainable NP = non plastic			
2.36 mm	98					
1.18 mm	98					
600 um	97					
425 um	95					
300 um	92					
150 um	80					
75 um	66					
Notes Sampling Method AS1289 1.2.1 (6.5.3)						



NATA Accredited Laboratory No. 14343
 Accredited for compliance with ISO/IEC 17025
 The results of the tests, calibrations and/or
 measurements in this document are traceable to
 Australian/National Standards

Date:

Whell Et

Approved Signatory

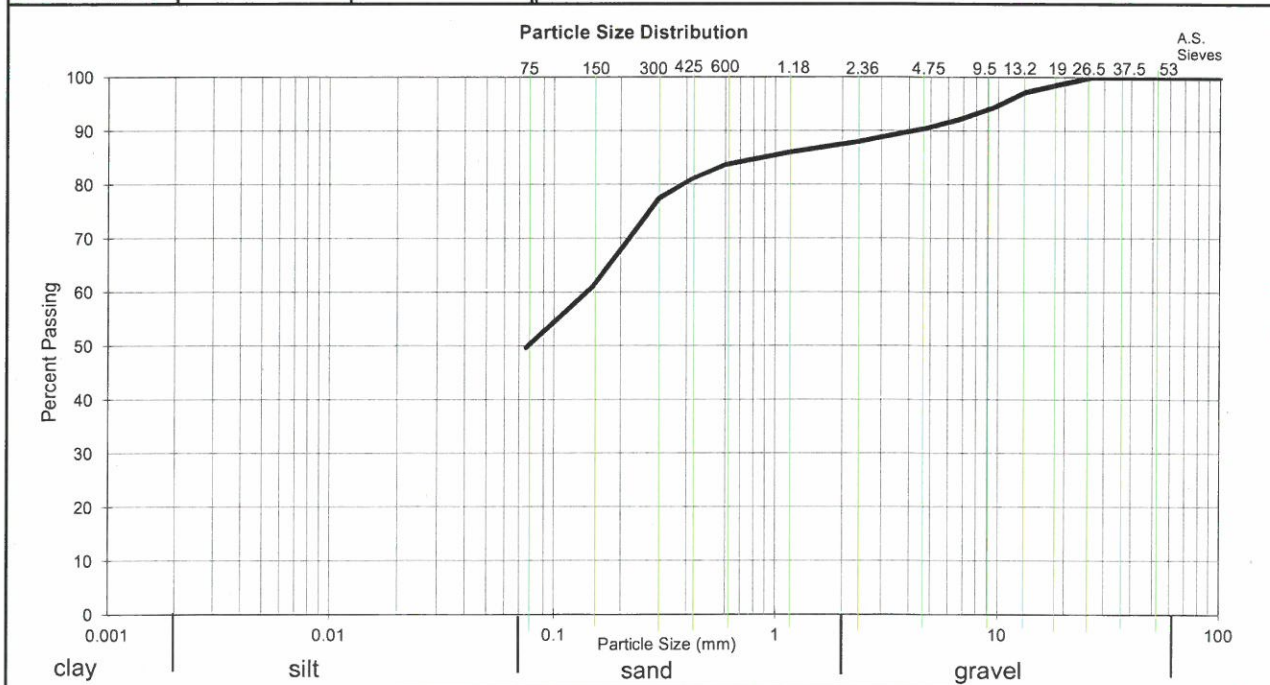
Geotechnical Testing Services

Particle Size Distribution & Atterberg Limits Test Report

Client:	Northern Suburbs Football Association	Job No.	GTE634
Project:	Norman Griffiths Oval	Test Date:	11-Sep-15
Location:	Norman Griffiths Oval, West Pymble	Report No.	GTER634-L2
Lab Reference No.	L1	Sample Location:	BH02 0.2 - 1.1m

Laboratory Specimen Classification: Mottled Red/Brown Sandy Silty Clay with some Gravel

Particle Size Distribution AS1289 3.6.1			Consistency Limits and Moisture Content			
Sieve Size	% Passing	Specification	Test	Method	Result	Spec.
150 mm	100		Liquid Limit	% AS1289 3.1.2	41	
75 mm	100		Plastic Limit	% AS1289 3.2.1	17	
53 mm	100		Plasticity Index	% AS1289 3.3.1	24	
37.5 mm	100		Linear Shrinkage	% AS1289 3.4.1	ND	
26.5 mm	100		Moisture Content	% AS1289 2.1.1	17.1	
19.0 mm	99		Sample History: Oven Dried			
13.2 mm	97		Preparation Method: Dry sieved			
9.5 mm	94		Crumbling / Curling of linear shrinkage:			
6.7 mm	92		Linear shrinkage mould length: 250 mm			
4.75 mm	90		ND = not determined NO = not obtainable NP = non plastic			
2.36 mm	88					
1.18 mm	86					
600 um	84					
425 um	81					
300 um	77					
150 um	61					
75 um	50					
Notes Sampling Method AS1289 1.2.1 (6.5.3)						



NATA Accredited Laboratory No. 14343
 Accredited for compliance with ISO/IEC 17025
 The results of the tests, calibrations and/or
 measurements in this document are traceable to
 Australian/National Standards

Date:

Whell. O.

Approved Signatory

CALIFORNIAN BEARING RATIO

Client	Northern Suburbs Football Association	Job no :	GTE634
Project	Norman Griffiths Oval	Test date :	21-Sep-15
Location	Norman Griffiths Oval , West Pymble	Report No.	GTE634-L1

Sample Number	L1	L2		
Date Sampled	11-Sep-15	11-Sep-15		
Depth	0.2-1.1m	0.2-1.0m		
Location	BH2	BH6		

Laboratory Compaction AS1289 5.1.1 standard

Oversize Material 19mm Sieve	%	1.1	0.5		
Maximum Dry Density	t/m ³	1.77	1.60		
Optimum Moisture Content	%	17.0	22.5		
Field Moisture Content	%	17.0	22.0		

Test Results AS 1289 6.1.1

Before Soaking	Dry Density t/m ³	1.76	1.60		
	Moisture Ratio %	103.0	102.0		
	Density Ratio %	99.5	100.0		
After Soaking	Dry Density t/m ³	1.76	1.59		
	Moisture Content %	17.5	22.9		
	Moisture Content after test - remainder %	18.1	23.8		
	Moisture Content after test - top 30mm %	19.0	24.7		
	Number of days soaking days	4	4		
	Mass of Surcharge Kg	4.5	4.5		
	Swell after soaking %	0.5	1.0		
	CBR penetration mm	5.0	2.5		
CBR VALUE	%	4.5	6		

Material Description : L1 Mottled Red/Brown Sandy Silty Clay with some Gravel L2 Mottled Red/Brown Sandy Clay
 Material Retained on 19mm was excluded from the test.

Test Methods: AS1289 6.1.1, 5.1.1, 2.1.1 Sampling : AS1289 1.2.1 (6.5.3)



NATA Accredited Laboratory No. 14343
 Accredited for compliance with ISO/IEC 17025

Khell El

Approved Signatory
 Date

23-Sep-15