CIVIL TEST PTY LTD
SOIL TESTING & GEOTECHNICAL CONSULTANTS
ABN 91 006 855 689
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A REPORT ON THE SOIL INVESTIGATION AND PAVEMENT DESIGN FOR

LOT 914 DP756961 PITMAN AVENUE

BURONGA

Report Nº: 3190369-2 Issue 2

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Also at: Mitcham (03) 9874 5844, Wodonga (02) 6024 4343 and Wonthaggi (03) 5672 3900

TABLE OF CONTENTS

CLIENT	:	Far West Local Health District PO Box 457 BROKEN HILL NSW 2880
AUTHORISED BY	:	Ms Anya Isarotaikul
PROJECT	:	Lot 914 DP756961 Pitman Avenue BURONGA
COMMISSION	:	Carry out appropriate insitu soil tests and observations at three locations as shown on the attached plan (Appendix A). Recommend a pavement composition for the carpark and service roads in accordance with the method outlined in AUSTROADS (2012): 'Guide to Pavement Technology Part 2: Pavement Structural Design' using the indicative traffic loading provided in the above design guide.

1 INTRODUCTION:

1.1 Aim

This report discusses the field investigation carried out on 31 July 2019 and the subsequent laboratory tests for the proposed construction of the carpark and service road.

The report closes with a recommendation for the pavement composition and any other treatment that may be appropriate for the construction process based on the field and laboratory data.

1.2 Statement of Expected Pavement Performance

The pavements recommended in this report have been designed using state of the art technology in pavement design. The essential part of the design is to ensure that each layer within the pavement is compatible - in terms of characteristics and strength - with those of the adjacent layers, so that the overall pavement performance criteria can be met. The pavements recommended in this report may not meet specific standardisation requirements of some local authorities and therefore such standard pavements may not be applicable for the project reported on herein.

It is expected that the subgrade will exhibit a characteristic deflection - that is a rebound deflection of the mean plus 1.5 times the standard deviation - of up to 4mm on completion of preparation as detailed. It is also expected that prior to asphalting the base course will have similar deflections of up to 2mm after preparation.

The pavement has been designed for a theoretical life of 20 years based on the traffic loadings nominated. At the end of its life, a pavement is expected to have deviations (ruts) and surface cracking (crazing).

2 SOURCE OF INFORMATION:

2.1 Civiltest Pty Ltd - Field and Laboratory data collected and recorded.

2.2 AUSTROADS (2012): 'Guide to Pavement Technology Part 2: Pavement Structural Design'

3 INVESTIGATION:

3.1 Field Work

The field work was carried out on 31 July 2019 by mechanically augering test bores at the approximate locations as shown on the attached plan (Appendix A).

California Bearing Ratio (CBR) values were obtained at each bore site using a 9kg Dynamic Cone. Insitu moisture contents were also obtained throughout each bore to assist in the assessment of the CBR values.

Insitu moisture contents were determined on the bulk samples.

All the field data is presented on the logs of boring (Appendix B).

3.2 Laboratory Work

Representative subgrade samples of the predominant subgrade material types were remoulded in a CBR mould using standard compactive effort at approximately the optimum moisture content. The samples were then soaked for four days under a 4.5kg surcharge before being tested to determine the laboratory soaked CBR value.

Classification tests (Plasticity Index and Sieve Analysis) were carried out on the predominant subgrade material types to assess the reactivity and the drainage characteristics for the site.

All the laboratory data is attached (Appendix C).

4 FINDINGS:

4.1 Field Work

The test bores revealed that the existing soil profile consisted of SAND FILL overlying the naturally occurring clayey SAND.

The insitu CBR values - determined using a 9kg dynamic cone - of the subgrade material ranged from 8.0% to 22.2% at insitu moisture contents of 6.1% and 6.0% respectively. There was no correlation between the insitu moisture contents and CBR values in the field at this site.

4.2 Laboratory Work

The results of the laboratory tests are set out in the table below:

Test Pit No.	Material Description	Sample No.	CBR %	Density t/m^3	Moisture %	Reactivity	PI %	%Pass 0.075mm
1	SAND	193-4094A	12	1.89	11.0	Low	7	28
2	Clayey SAND	193-4094D	20	1.89	12.0	Low	7	30
3	SAND	193-4094G	25	1.81	10.0	Low	Non Plastic	12

5 DESIGN SUBGRADE VALUE AND SUBGRADE DELINEATION:

After reviewing the soil profiles in the field and the laboratory test results, it was considered that a subgrade design CBR value of 8.0% should be adopted for clayey SAND subgrade materials for the pavements in this project.

6 TRAFFIC LOADINGS:

In the absence of site specific traffic data, the following traffic loading has been obtained from Table 12.2 of AGPT02 AUSTROADS (2012) 'Guide to Pavement Technology Part 2: Pavement Structural Design'. Using the case of 'Local access in industrial area', a maximum design loading of 1.5 x 10^5 Equivalent Standard Axles (ESA) has been adopted. The receiver of the report should check if the assumption made in regards to the design traffic loading is correct. Civiltest Pty Ltd should be contacted if the design traffic loading differs, so that a review of the recommendations can be made.

7 DISCUSSION:

It has been established that the subgrade design CBR value is 8.0% and the design traffic loading is 1.5 x 10^5 Equivalent Standard Axles (ESA). Therefore, for a 95% reliability level in pavement performance, the overall pavement depth should be 300mm.

8 RECOMMENDATIONS:

8.1 Flexible Pavements:

		Depth 00mm
WEARING COURSE (40mm thick)	AC 10mm	40mm
7mm Low Cutter Seal		
BASE (120mm thick)	DGB Compacted to not less than 98% of AS 1289, 5.2.1 (Modified Compaction)	160mm
SUBBASE (140mm thick)	DGS40 Compacted to not less than 95% of AS 1289, 5.2.1 (Modified Compaction)	300mm
SUBGRADE	Material as found Compacted to 95% of AS 1289 5.1.1 (Standard Compaction) at a moisture content between 90% and 120% of Optimum Moisture Content for a depth of 150mm	

8. RECOMMENDATIONS (CONT.):

The above recommendations have been made based on (I) the field investigations for the project, (2) the laboratory work detailed within this report, (3) information received from the client and (4) information from the references mentioned in Section 2. SOURCE OF INFORMATION. Therefore if it is found that during construction, conditions differ widely to those described in this report or information received is found to be incorrect, then the recommendations made in this report may need to be amended.

The recommendations given in this report have been based largely on the soil conditions encountered at the time of the field investigation. Under inclement weather or prolonged wet weather conditions, the soil conditions noted and reported in this report could vary. It is advisable to undertake construction during and following good weather conditions - i.e., dry weather conditions - not during or following inclement weather or prolonged wet weather conditions.

It is also assumed that the pavements will be using established sound engineering practices by a contractor experienced in this field of work using purpose built equipment.

Zhan Tang
Geotechnical Engineer
CIVILTEST PTY LTD

REF: RG/LG/YW/ZT/JY/hj

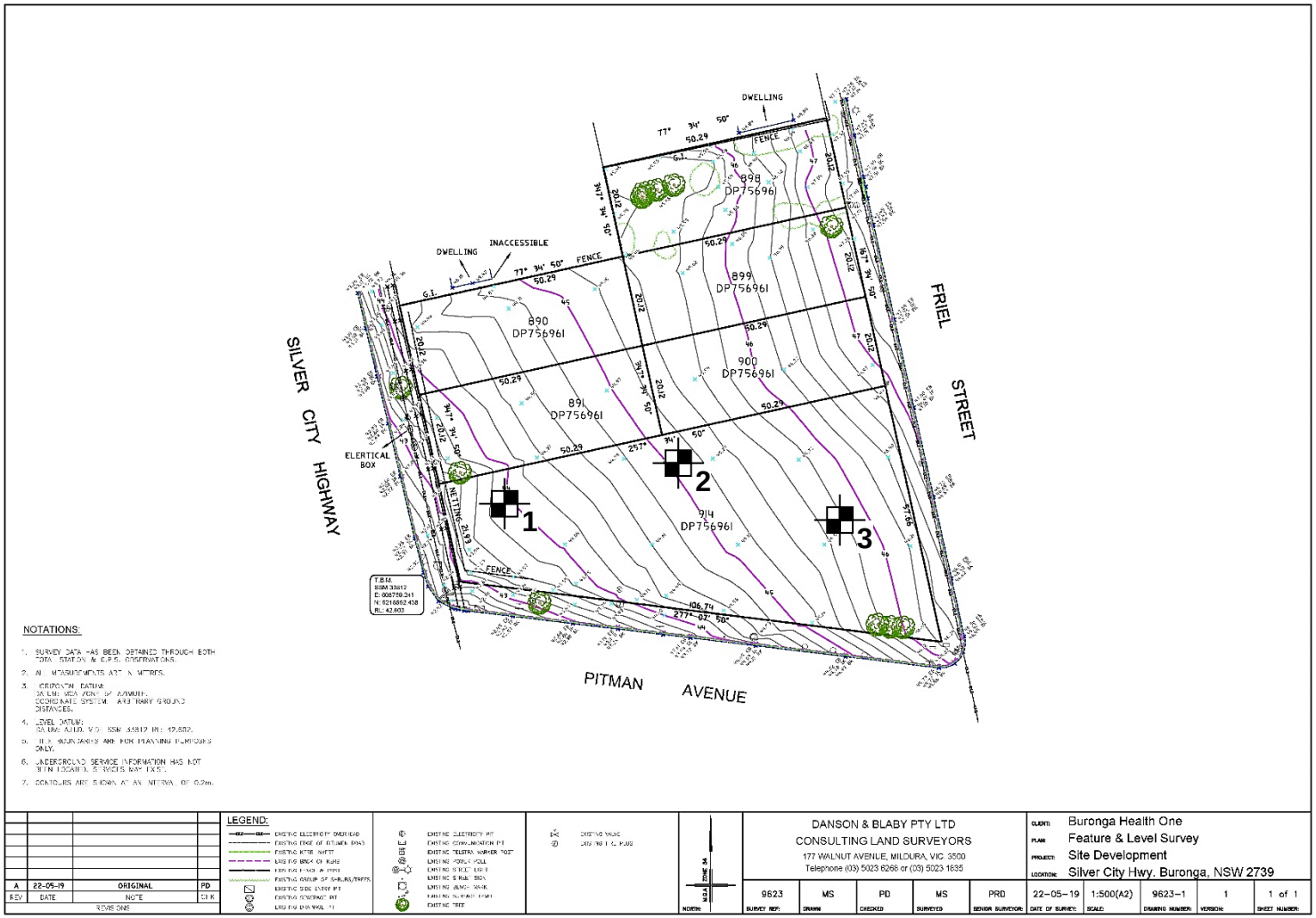
30 August 2019

AMENDMENT: *This report was first issued on 26 August 2019. Sections of this report were amended on 30 August 2019 and consequently this revised report now takes precedence over any previously dated report.*

APPENDIX A

SITE PLAN

LOCATION OF TEST SITES: LOT 914 DP756961 PITMAN AVENUE BURONGA



Denotes Test Pits

THIS SKETCH IS NOT INTENDED TO BE AN ACCURATE DEPICTION OF THE NUMBER, SIZE OR LOCATION OF TREES AND/OR SHRUBS

NOT TO SCALE

APPENDIX B

LOGS OF BORING

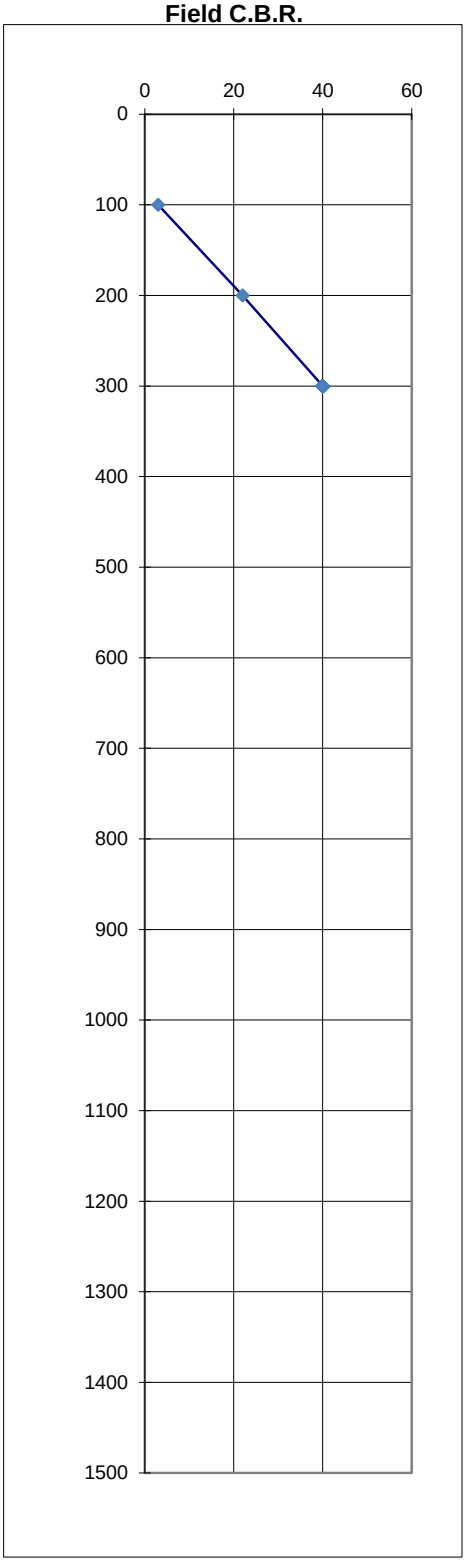
CIVILTEST P/L. **ENGINEERING LOG** Report Number: 3190369-2

Soil Testing & Geotechnical Consultants

CIV-DOC-001-011-SD2 ISSUE # 6 - 22 January 2015 **TEST PIT 1**

Field Moisture Content (%)	Depth (m)	Soil Class	Test Methods
			Moisture content: AS 1289.2.1.1
			DCP CBR: AS 1289.6.3.2, RC 402.01
	0.100	. . .	SAND, trace clay FILL Brown, Moist, Medium dense — FILL
5.0	0.500	. . .	SAND, trace clay With limestone Brown Moist Medium dense
5.1	1.000	. . .	
	1.500	. . .	
			END OF BORE (31-07-19)

Field C.B.R.



Ref: RG/LG/hj

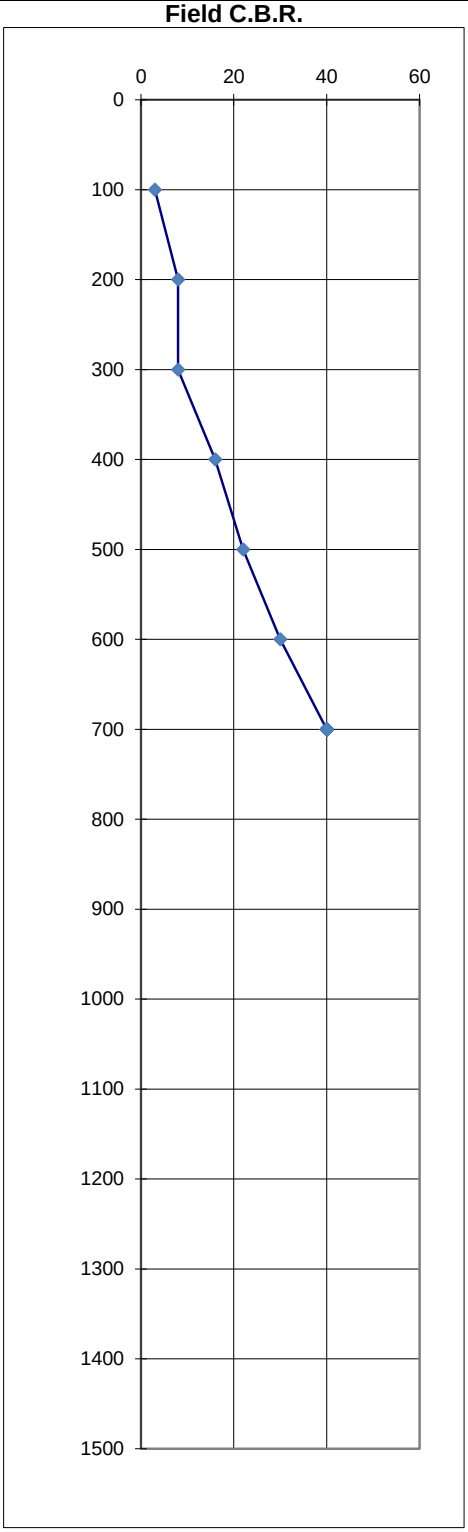
CIVILTEST P/L. **ENGINEERING LOG** Report Number: 3190369-2

Soil Testing & Geotechnical Consultants

ISSUE # 6 - 22 January 2015

TEST PIT 2

Field Moisture Content (%)	Depth (m)	Soil Class	Field C.B.R.	Test Methods: Moisture content AS 1289.2.1.1; DCP CBR: AS 1289.6.3.2, RC 402.01
	0.100	. . .		SAND, trace clay FILL Brown, Moist, Medium dense **FILL**
6.1	0.500 0.700	. . .		SAND, clayey With limestone Brown Moist Medium dense
6.0	1.000 1.500	. . .		SAND, clayey, trace silt Pale brown Moist Medium dense
				END OF BORE (31-07-19)



Ref: RG/LG/hj

CIVILTEST P/L. **ENGINEERING LOG** Report Number: 3190369-2

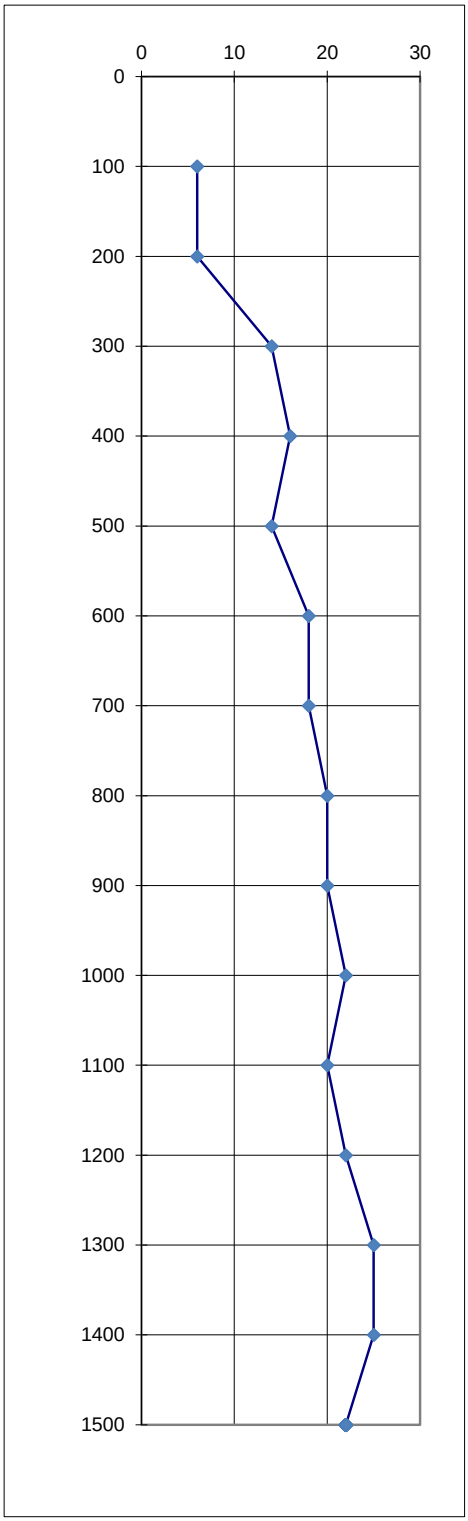
Soil Testing & Geotechnical Consultants

ISSUE # 6 - 22 January 2015

TEST PIT 3

Field Moisture Content (%)	Depth (m)	Soil Class	Test Methods: Moisture content AS 1289.2.1.1; DCP CBR: AS 1289.6.3.2, RC 402.01
	0.100	. . .	SAND, trace clay FILL Brown, Moist, Medium dense — **FILL**
5.6	0.500	. . .	SAND, trace clay Brown Moist Medium dense
2.8	1.000	. . .	
	1.500	. . .	
			END OF BORE (31-07-19)

Field C.B.R.



Ref: RG/LG/hj

APPENDIX C

ENGINEERING DATA

Material Test Report

Report Number: **3190369-3**
Issue Number: 1
Date Issued: 07/08/2019
Client: Far West Local Health District
PO Box 457 , BROKEN HILL NSW 2880
Contact: Anya - Currie & Brown
Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Sample Number: 193-4094A
Date Sampled: 31/07/2019
Dates Tested: 31/07/2019 - 02/08/2019
Sampling Method: AS1289 1.2.1 6.5.3 - Power auger drilling
Sample Location: **TP1 (100mm-1500mm)**

CIVIL TEST PTY LTD
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SOIL TESTING & GEOTECHNICAL CONSULTANTS

Civiltest Pty Ltd
Mildura Laboratory
Unit 2/48 Tenth Street Mildura Vic 3500
Phone: (03) 5023 2870
Email: james@civiltest.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

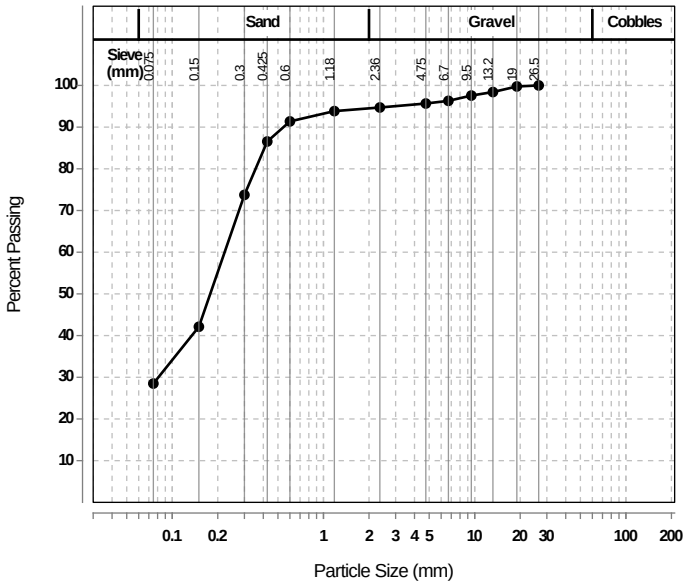
Approved Signatory: James Taylor
Laboratory Manager
NATA Accredited Laboratory Number: 10784

Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**98**			1		
9.5 mm	**98**			1		
6.7 mm	**96**			1		
4.75 mm	**96**			1		
2.36 mm	**95**			1		
1.18 mm	**94**			1		
0.6 mm	**91**			2		
0.425 mm	**87**			5		
0.3 mm	**74**			13		
0.15 mm	**42**			32		
0.075 mm	**28**			14		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	19		
Plastic Limit (%)	12		
Plasticity Index (%)	**7**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	1.0		
Cracking Crumbling Curling	Cracking		

Particle Size Distribution



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Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Sample Number: 193-4094A
Date Sampled: 31/07/2019
Dates Tested: 31/07/2019 - 06/08/2019
Sampling Method: AS1289 1.2.1 6.5.3 - Power auger drilling
Sample Location: **TP1 (100mm-1500mm)**

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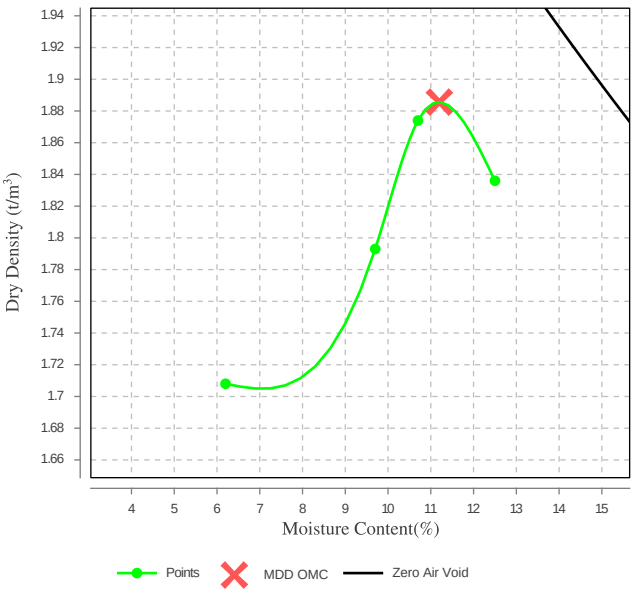
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.89
Optimum Moisture Content (%)	11.0
Retained on 19mm (%)	0.4
Oversize Sieve (mm)	19
Oversize Material Wet (%)	
Oversize Material Dry (%)	
Dry Oversize density (t/m^3)	
Method used to Determine Plasticity	Estimated
Curing Hours	

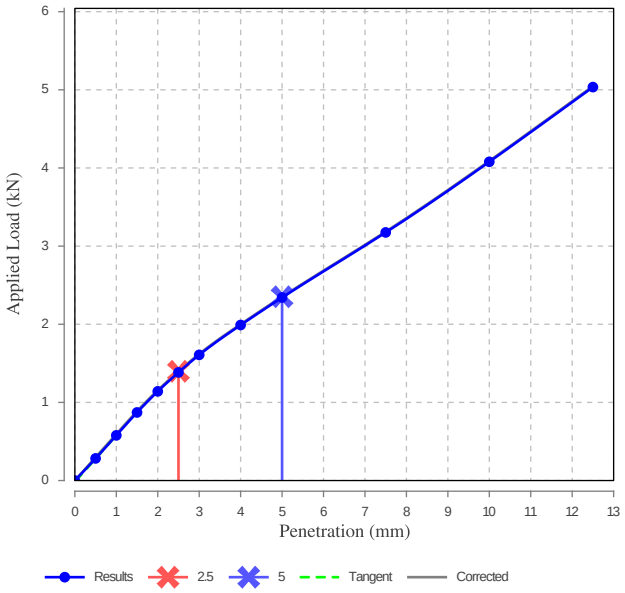
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	4.6

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**12**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Estimated		
Maximum Dry Density (t/m^3)	1.89		
Optimum Moisture Content (%)	11.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	98.0		
Moisture Content at Placement (%)	11.0		
Moisture Content Top 30mm (%)	13.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			

Moisture Density Relationship



California Bearing Ratio



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Contact: Anya - Currie & Brown
Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Sample Number: 193-4094D
Date Sampled: 31/07/2019
Dates Tested: 31/07/2019 - 02/08/2019
Sampling Method: AS1289 1.2.1 6.5.3 - Power auger drilling
Sample Location: **TP2 (300mm-1500mm)**

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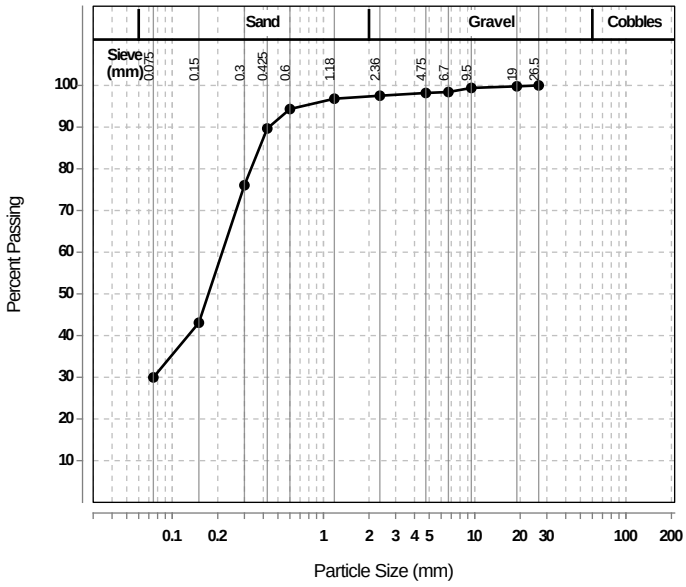
Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
9.5 mm	**99**			0		
6.7 mm	**98**			1		
4.75 mm	**98**			0		
2.36 mm	**98**			1		
1.18 mm	**97**			1		
0.6 mm	**94**			2		
0.425 mm	**90**			5		
0.3 mm	**76**			14		
0.15 mm	**43**			33		
0.075 mm	**30**			13		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	20		
Plastic Limit (%)	13		
Plasticity Index (%)	**7**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	1.5		
Cracking Crumbling Curling	Cracking		

Particle Size Distribution



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Contact: Anya - Currie & Brown
Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Sample Number: 193-4094D
Date Sampled: 31/07/2019
Dates Tested: 31/07/2019 - 06/08/2019
Sampling Method: AS1289 1.2.1 6.5.3 - Power auger drilling
Sample Location: **TP2 (300mm-1500mm)**

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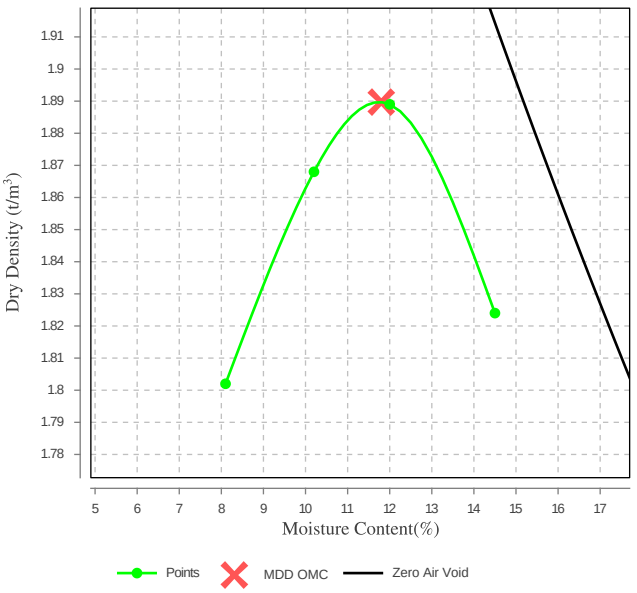
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.89
Optimum Moisture Content (%)	12.0
Retained on 19mm (%)	0.3
Oversize Sieve (mm)	19
Oversize Material Wet (%)	
Oversize Material Dry (%)	
Dry Oversize density (t/m^3)	
Method used to Determine Plasticity	Estimated
Curing Hours	

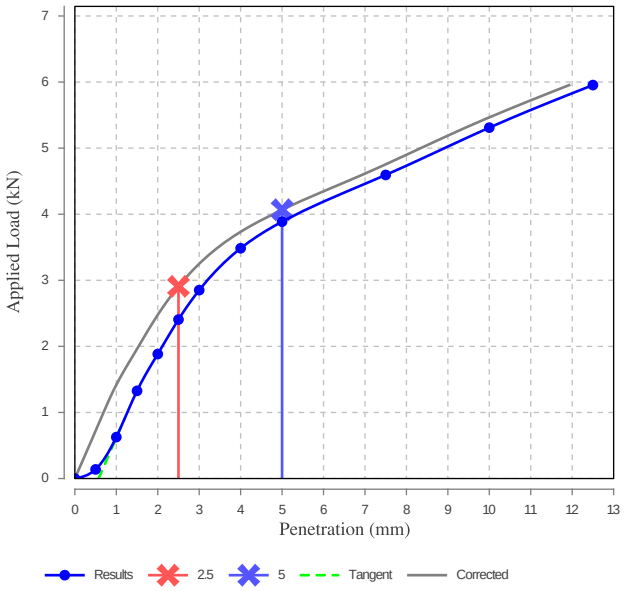
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	6.2

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**20**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Estimated		
Maximum Dry Density (t/m^3)	1.89		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	93.0		
Moisture Content at Placement (%)	11.0		
Moisture Content Top 30mm (%)	16.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			

Moisture Density Relationship



California Bearing Ratio



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Contact: Anya - Currie & Brown
Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Sample Number: 193-4094G
Date Sampled: 31/07/2019
Dates Tested: 31/07/2019 - 05/08/2019
Sampling Method: AS1289 1.2.1 6.5.3 - Power auger drilling
Sample Location: **TP3 (1000mm-1500mm)**

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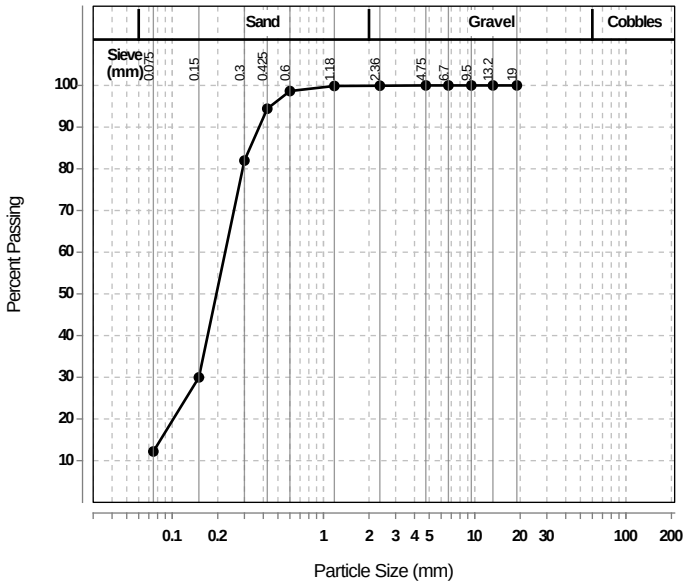
Approved Signatory: James Taylor
Laboratory Manager
NATA Accredited Laboratory Number: 10784

Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**100**			0		
0.6 mm	**99**			1		
0.425 mm	**94**			4		
0.3 mm	**82**			12		
0.15 mm	**30**			52		
0.075 mm	**12**			18		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	Not Obtainable		
Plastic Limit (%)	Not Obtainable		
Plasticity Index (%)	**Non Plastic**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	0.0		
Cracking Crumbling Curling	None		

Particle Size Distribution



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Sample Location: **TP3 (1000mm-1500mm)**

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Civiltest Pty Ltd
Mildura Laboratory
Unit 2/48 Tenth Street Mildura Vic 3500
Phone: (03) 5023 2870
Email: james@civiltest.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

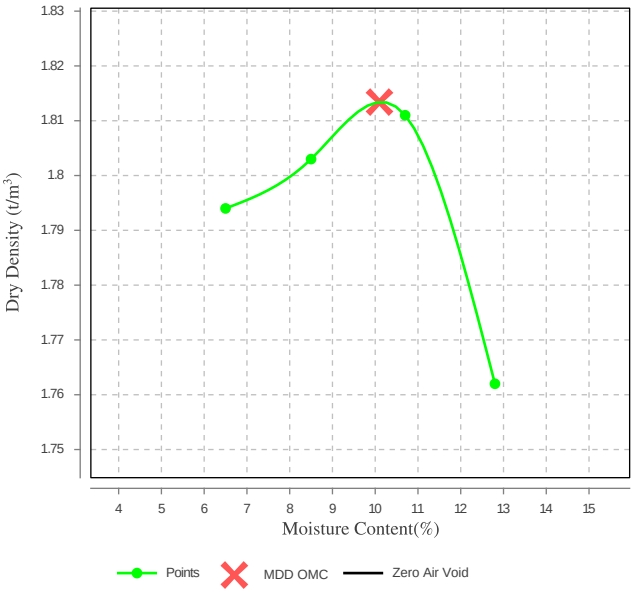
Approved Signatory: James Taylor
Laboratory Manager
NATA Accredited Laboratory Number: 10784

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.81
Optimum Moisture Content (%)	10.0
Retained on 19mm (%)	0.0
Oversize Sieve (mm)	19
Oversize Material Wet (%)	
Oversize Material Dry (%)	
Dry Oversize density (t/m^3)	
Method used to Determine Plasticity	Estimated
Curing Hours	

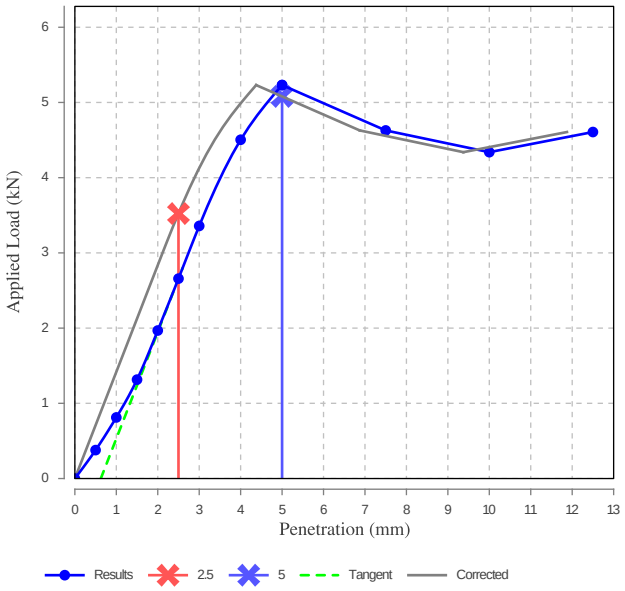
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	1.8

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**25**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Estimated		
Maximum Dry Density (t/m^3)	1.81		
Optimum Moisture Content (%)	10.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.0		
Moisture Content at Placement (%)	10.0		
Moisture Content Top 30mm (%)	14.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			

Moisture Density Relationship



California Bearing Ratio



The results reported only relate to the items tested or sampled.

Material Test Report

Report Number: **3190369-3**
Issue Number: 1
Date Issued: 07/08/2019
Client: Far West Local Health District
PO Box 457 , BROKEN HILL NSW 2880
Contact: Anya - Currie & Brown
Project Number: 3190369
Project Name: Lot 914 Pitman Avenue BURONGA
Project Location: Lot 914 Pitman Avenue BURONGA
Work Request: 4094
Dates Tested: 31/07/2019 - 31/07/2019

CIVIL TEST PTY LTD
ABN 91 006 855 689
SOIL TESTING & GEOTECHNICAL CONSULTANTS

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Moisture Content AS 1289 2.1.1			
Sample Number	Sample Location	Moisture Content	Material
193-4094B	TP1 (500mm)	5.0 %	**
193-4094C	TP1 (1000mm)	5.1 %	**
193-4094E	TP2 (500mm)	6.1 %	**
193-4094F	TP2 (1000mm)	6.0 %	**
193-4094H	TP3 (500mm)	5.6 %	**
193-4094I	TP3 (1000mm)	2.8 %	**