

**REPORT NO:** 3230047-1

**CLIENT:** Health Infrastructure  
1 Reserve Road  
St Leonards NSW

**PROJECT LOCATION:** Health Infra - Broken Hill Hospital  
BROKEN HILL

**COMMISSION:** Carry out appropriate in-situ soil tests and observations at ten locations as shown on the attached plan, to a depth of up to 6.0 metres.

Recommend allowable bearing pressures for slab, strip footings, pad footings, end bearing pressures and skin friction values for bored piers, and design parameters for retaining wall structures.

## 1. INTRODUCTION:

### 1.1 Aim:

This report discusses the field investigation carried out on 6 and 7 February 2023, for the proposed development of Broken Hill Hospital.

## 2. INVESTIGATION:

### 2.1 Site Geology:

Geological maps of the area suggest that the site is in an area of Quaternary Sediments - SAND and CLAYS. The natural soils encountered during the site investigation confirmed this.

### 2.2 Site Topography:

The ground surface over the site has a gentle fall to the south and north. The site around the existing double storey structure has been cleared and has remanence of natural grass regrowth. Photograph 1 shows the general site condition during the field investigation.



**Photograph 1:** General site condition during field investigation.

### **2.3 Fieldwork:**

The fieldwork consisted of drilling six boreholes (BHs) up to 4.5 metres depth with a mechanical auger and excavating four test pits to refusal depth of up to 950mm. The approximate locations of the boreholes and test pits are shown on the attached plan. Subsurface materials penetrated were visually classified to AS1726: Geotechnical Site Investigation. The engineering logs of each borehole are attached showing the soil descriptions and depths, along with any cohesive strengths measured and observed densities of non-cohesive soils.

Standard Penetration Testing (SPT) was conducted in BH6 at 1.5m depth only due to presence of weathered ROCK at shallow depth.

### 3. FINDINGS:

#### 3.1 Field Data:

The soil profile in the boreholes and test pits consisted of varying depths of FILL overlying the naturally occurring sandy CLAY. The FILL comprised of crushed ROCK with broken brick pieces and silty SAND. Auger refusal was encountered in the FILL during the drilling of the boreholes and also excavation of test pits. Depth of FILL and refusal are summarised in the table 1.

**Table 1:** Depth of FILL and refusal

Borehole	Depth of FILL (m)	Depth to auger and excavation refusal (m)
BH1	0.7	0.7
BH2	1.1	1.1
BH3	0.6	0.6
BH4	0.5	0.5
BH5	0.7	0.7
BH6	2.5	4.5
TP1	0.65	0.65
TP2	0.95	0.95
TP3	0.75	0.75
TP4	0.55	0.55

Groundwater was not encountered in the boreholes during the field investigation.

Weathered rock was not encountered in the boreholes.

Substrata conditions encountered are such that infiltration and occurrence of perched water at the interface between different material layers should not be disregarded.

It is understood the existing building is to be demolished. Demolition may result in areas of isolated FILL which will require additional deepening of new foundations into the underlying natural undisturbed soils, and the existing building may have caused abnormal moisture contents beneath the building, both of which may result in some differential moisture contents across the site which could affect foundation performance. This should be considered in the design of foundations, and the presence or not of abnormal moisture conditions will require additional special testing to be carried out after demolition but just prior to construction.

#### 3.2 Laboratory Data:

Classification tests (Plasticity Index and Sieve Analysis) were carried out on samples collected to assess the plasticity character and the drainage characteristics and estimate the reactivity of the predominant onsite soils. The laboratory test results are appended to this report in Appendix B, in summary:

**Table 2:** Summary of Atterberg Limits and Sieve Analysis Results

Location	Percent passing 0.075mm	Liquid Limit (%)	Plasticity Index (%)
BH6 at 1000mm	34	Not Obtainable	Non-Plastic
BH6 at 3500mm	35	22	7
TP1 at 0-600mm	15	Not Obtainable	Non-Plastic
TP2 at 0-900mm	12	Not Obtainable	Non-Plastic
TP3 at 0-700mm	11	Not Obtainable	Non-Plastic
TP4 at 0-500mm	16	Not Obtainable	Non-Plastic

Representative samples of the onsite materials likely to be used in the construction were subjected to soil aggressivity testing. The laboratory test results are appended to this report in Appendix B. The test results of soil samples indicate that the tested exposure classification is non-aggressive when compared to the following documents:

Tables 6.5.2(A), 6.5.2(B) and 6.5.2(C) of AS2159

And

Table 4.8.1 of AS3600 – 2009.

In addition to the Soil Classification tests and Aggressivity suite testing, samples of the encountered ROCK on site were subjected to Point Load Index (PLI). The following table (Table 3) summarises the PLI test results of the supplied ROCK specimens. The locations of the rock samples are based on the information provided by the clients office and the strength descriptions have been made in accordance with Table 19 of Australian Standard AS1726:2017.

**Table 3:** Point Load Strength Index Test Results

<b>Sample Number &amp; Test Pit</b>	<b>Point Load Index <math>I_{s(50)}</math> (MPa)</b>	<b>Indicated Unconfined Compressive Strength (MPa)</b>	<b>Strength base on AS1726:2017 Table 19</b>
233-10131G Test Pit 1	7.10	141.95	Very High
233-10131G Test Pit 2	0.70	13.96	Medium
233-10131G Test Pit 3	1.21	24.28	High
233-10131H Test Pit 1	1.24	24.85	High
233-10131H Test Pit 2	0.37	7.45	Medium
233-10131H Test Pit 3	1.69	33.81	High
233-10131I Test Pit 1	0.63	12.60	Medium
233-10131I Test Pit 2	0.53	10.61	Medium
233-10131I Test Pit 3	0.70	13.96	Medium
233-10131J Test Pit 1	0.14	2.87	low
233-10131J Test Pit 2	1.79	35.76	High
233-10131J Test Pit 3	0.07	1.41	very low

#### 4. SITE CLASSIFICATION:

Based on the site investigation and the geology of the area, this site would be classified as CLASS P with respect to Australian Standard 2870-2011 (Residential Slabs and Footings) due to the depth of FILL encountered in the boreholes. However, this classification is technically not correct for the proposed type of structure, therefore is given as a guide only.

It is anticipated that the normal seasonal surface movement at this site, without considering any abnormal moisture conditions, will not exceed 40mm. It must be emphasised that the seasonal surface movement mentioned, and recommendations referred to in this report do not take into account the effects of any abnormal moisture conditions that may develop after construction as defined in Clause 1.3.3 (A) (B) (C) (D) (E).

Trees in the vicinity of the proposed development will cause future abnormal moisture conditions, and consequently the footings will have a higher probability of damage than that given in Clause 1.3.1 of AS2870 – 2011. The designer of the footing system should take this into account.

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.

#### 5. RECOMMENDATIONS:

##### 5.1 Building Foundations:

###### 5.1.1 Pad Footings, Strip Footings, and Edge Beams:

Pad and strip footings or a stiffened raft slab are not appropriate shallow foundation arrangement for the proposed development due to the depth of FILL encountered in boreholes and test pits.

In accordance with Appendix D of AS2870 – 2011 the soil profile and site conditions should be inspected at footing excavation stage by CIVILTEST PTY LTD to confirm the soil profile, allowable bearing capacities, and site classification.

###### 5.1.2 Deep Foundations:

If deep foundations are required for the proposed development, bored piers would be a suitable option.

The following parameters can be adopted for the design of bored pier or pile foundations:

Depth from Existing Ground / Floor Level (mm)*	Borehole No.	Consistency and Type of Anticipated Material	Allowable End Bearing Capacity (kPa)	Allowable Skin Friction (kPa)
2500	6	Sandy CLAY Stiff	200	25
3000	6	Sandy CLAY Stiff	240	30
4000	6	Sandy CLAY Stiff	280	30
4500	6	Sandy CLAY Stiff	320	30

\*The founding material types and depths vary over the site. Deeper FILL may be encountered in some areas. The bearing guide above should be read in conjunction with the engineering logs attached.

In accordance with Appendix D of AS2870 – 2011 the soil profile and site conditions should be inspected at footing excavation stage by CIVILTEST PTY LTD to confirm the soil profile and site classification.

### **5.1.3 Floor Slab:**

The floor slab and any internal stiffening beams may be placed on or in the existing natural soils as described in the engineering logs. This is providing that any soft areas have been well compacted with a small vibratory roller or vibratory plate compactor, with the soil in a moist condition. This material will provide a subgrade for the slab and based on the field observations can be assumed to have a modulus of subgrade reaction of 30kPa/mm.

Where levelling fill is used the floor slab and any internal stiffening beams required may be placed on or in levelling fill provided that not more than 300mm of site derived clayey or 600mm of site derived sandy or imported granular fill, including existing fill material excluding perishable and organic matter if any is used. Stripped or imported fill meeting the minimum suitability requirements of section 4 of AS3798 must be placed at maximum 200mm loose uncompacted layers. Each layer shall be compacted to a minimum 98% dry density ratio at moisture content between 85% and 115% of the optimum moisture content. Following the above preparation, an allowable bearing pressure of 80kPa can be assumed at 200mm below the compacted surface. If significant amounts of fill are placed under the floor slab, then the above parameters and the site classification will need to be reviewed.

In accordance with Appendix D of AS2870 – 2011 the soil profile and site conditions should be inspected at footing excavation stage by CIVILTEST PTY LTD to confirm the soil profile and site classification.

## 5.2 Retention System

### 5.2.1 Design Parameters

The following parameters can be used for WALLAP analysis in the design of a retention system. These values assume that the soil being retained/supported has a horizontal surface.

Soil Strata description	Unit Weight (kN/m <sup>3</sup> ) $\gamma$	Poisson's Ratio $\nu$	Parameters for Short Term Analysis						Parameters for Long Term Analysis					
			K <sub>o</sub>	K <sub>a</sub>	K <sub>p</sub>	C <sub>u</sub> (kPa)	$\phi_u$ (deg)	E <sub>u</sub> (MPa)	K <sub>o</sub>	K <sub>a</sub>	K <sub>p</sub>	c' (kPa)	$\phi'$ (deg)	E' (MPa)
Silty SAND FILL	17.5	0.37	0.53	0.36	2.77	1	28	30	0.47	0.31	3.25	0	32	25
Crushed ROCK FILL	20.0	0.35	0.41	0.26	3.85	1	36	45	0.46	0.22	4.60	0	40	35
Sandy CLAY	20.0	0.40	0.66	0.49	2.04	70	20	35	0.57	0.40	2.55	15	26	30

Where:

$\phi_u$	=	Undrained angle of shearing resistance under current unsaturated moisture condition
$\phi'$	=	Effective angle of shearing resistance
C <sub>u</sub>	=	Undrained cohesion under current unsaturated moisture condition
C'	=	Effective cohesion
E <sub>u</sub>	=	Undrained Elastic (Young's) modulus under current unsaturated moisture condition
E'	=	Effective Elastic (Young's) modulus
K <sub>a</sub>	=	Active earth pressure coefficient
K <sub>o</sub>	=	At-rest earth pressure coefficient
K <sub>p</sub>	=	Passive earth pressure coefficient

Allowable bearing pressures given under 5.1.1 and 5.1.2 are relevant for foundation loading. The above parameters assume that the level of the water table is below the bottom of the excavation by the use of adequate drainage and that any adjacent surcharge loads are superimposed.

## 6. CONDITIONS OF THE REPORT:

The recommendations made in this report may need to be reviewed should any site works disturb any soil 300mm below the founding depth of the structure.

Since the soil horizons and layers can vary in depth and thickness over the site, the depths and bearing pressure given above (i.e., in the report) are given as a guide only. If the footings are founded at the minimum depth as stated and are in the soil as described in the engineering logs for this site, then the requirements of this report have been met.

Where any filling is to be placed, the footing design parameters recommended in this report will need to be increased accordingly in relationship to the depth of that fill.

The descriptions of the soils found in the boreholes closely follow those outlined in AS1726-2017 (Geotechnical Site Investigations). Colour descriptions can vary with soil moisture content and exposure. It should be noted therefore, colour and shade descriptions mentioned in this report are made when the soil is in a moist condition.

This report has been compiled and recommendations made based on information supplied in the brief to Civiltest Pty Ltd and from the field investigation and observations made including the extent of, if any, site filling. Every care has been taken within the terms of the brief to ensure that the field investigation is representative of the site. Therefore, if it is found that for any reason information received by Civiltest Pty Ltd is incorrect or conditions on site vary considerably during construction to those described in this report then the comments and 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.

Finally, no responsibility will be taken for this report if it is altered in any way or is not reproduced in full.

This report consists of nine pages including a site plan. Appendices A (Engineering Logs) and B (Laboratory Test Results) are attached.



**PREETI KUMMARI**  
**GEOTECHNICAL ENGINEER**  
**CIVILTEST PTY LTD**

**REF:** IC/WO/pk/po/rb

08 March 2023



## LOCATION OF TEST SITES: BROKEN HILL HOSPITAL



⊕ Denotes Boreholes

⊞ Denotes Test Pits

**NOT TO SCALE**

# **APPENDIX A**

## **ENGINEERING LOGS**























## **APPENDIX B**

### **LABORATORY TEST RESULTS**

# Material Test Report

**Report Number:** 3230047-2  
**Issue Number:** 1  
**Date Issued:** 24/02/2023  
**Client:** Health Infrastructure  
 1 Reserve Road, ST LEONARDS NSW 2065  
**Contact:** Steven Bird - CWPM  
**Project Number:** 3230047  
**Project Name:** Broken Hill Hospital BROKEN HILL  
**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131A  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** BH 6 @ 1000



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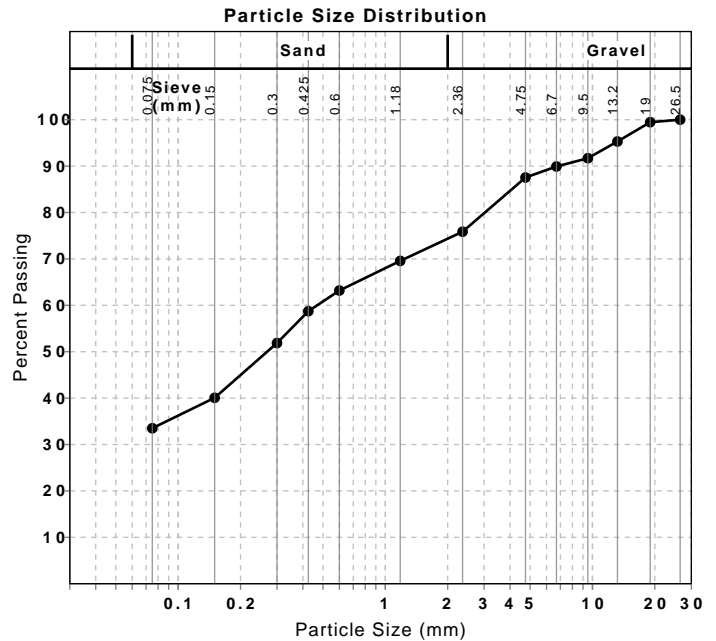


Approved Signatory: James Taylor  
 Laboratory Manager  
 NATA Accredited Laboratory Number: 10784

Particle Size Distribution (AS1289 3.6.1)				
Sieve	Passed %	Passing Limits	Retained %	Retained Limits
26.5 mm	100		0	
19 mm	99		1	
13.2 mm	95		4	
9.5 mm	92		4	
6.7 mm	90		2	
4.75 mm	88		2	
2.36 mm	76		12	
1.18 mm	70		6	
0.6 mm	63		6	
0.425 mm	59		4	
0.3 mm	52		7	
0.15 mm	40		12	
0.075 mm	34		7	

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven 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
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			



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**Contact:** Steven Bird - CWPM  
**Project Number:** 3230047  
**Project Name:** Broken Hill Hospital BROKEN HILL  
**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131B  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** BH 6 @ 3500



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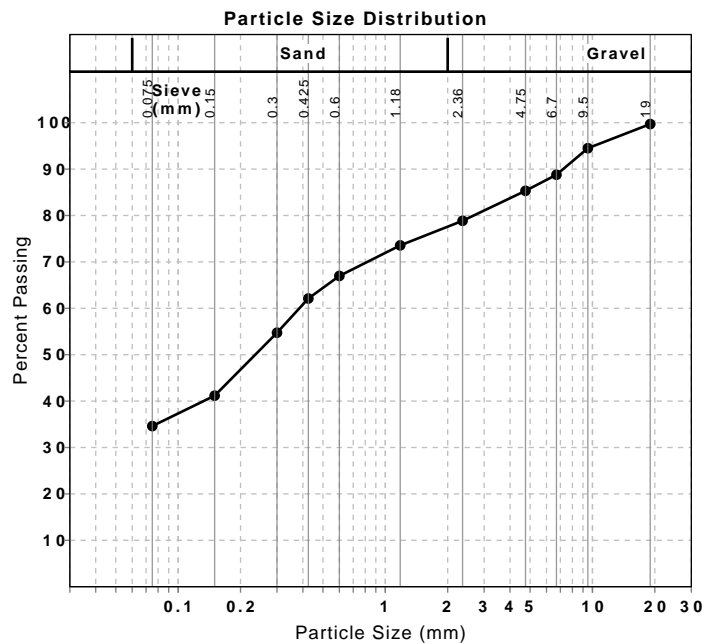


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 Laboratory Manager  
 NATA Accredited Laboratory Number: 10784

Particle Size Distribution (AS1289 3.6.1)					
Sieve	Passed %	Passing Limits	Retained %	Retained Limits	
19 mm	100		0		
9.5 mm	94		5		
6.7 mm	89		6		
4.75 mm	85		3		
2.36 mm	79		6		
1.18 mm	74		5		
0.6 mm	67		7		
0.425 mm	62		5		
0.3 mm	55		7		
0.15 mm	41		14		
0.075 mm	35		7		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)			Min	Max
Sample History	Oven Dried			
Preparation Method	Dry Sieve			
Liquid Limit (%)	22			
Plastic Limit (%)	15			
Plasticity Index (%)	7			

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	4.0		
Cracking Crumbling Curling	Cracking		



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**Project Name:** Broken Hill Hospital BROKEN HILL  
**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131C  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** TP 1 @ 0-600



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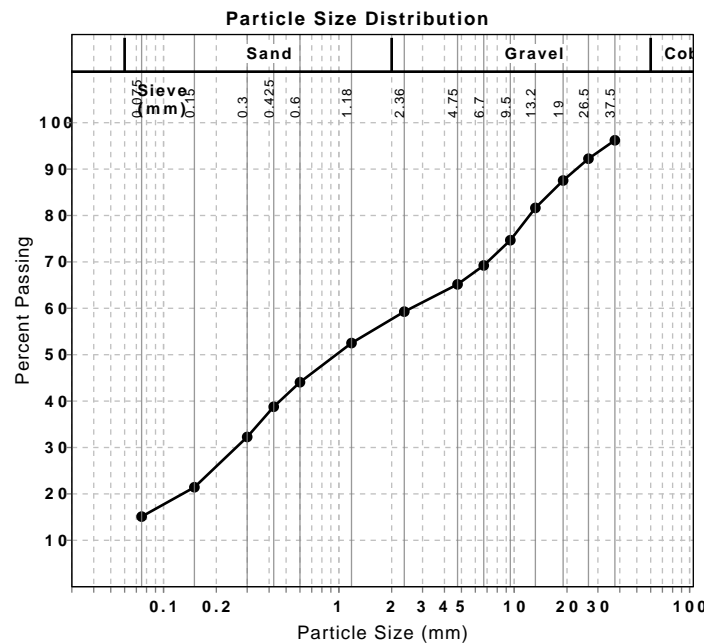


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Particle Size Distribution (AS1289 3.6.1)				
Sieve	Passed %	Passing Limits	Retained %	Retained Limits
37.5 mm	96		4	
26.5 mm	92		4	
19 mm	88		5	
13.2 mm	82		6	
9.5 mm	75		7	
6.7 mm	69		5	
4.75 mm	65		4	
2.36 mm	59		6	
1.18 mm	53		7	
0.6 mm	44		8	
0.425 mm	39		5	
0.3 mm	32		7	
0.15 mm	21		11	
0.075 mm	15		6	

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven 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
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			





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**Project Number:** 3230047  
**Project Name:** Broken Hill Hospital BROKEN HILL  
**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131D  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** TP 2 @ 0-900



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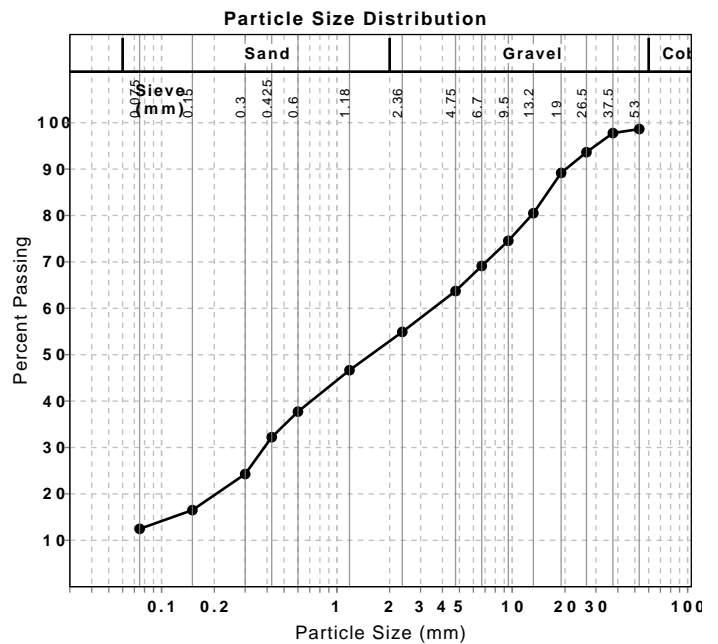


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Particle Size Distribution (AS1289 3.6.1)				
Sieve	Passed %	Passing Limits	Retained %	Retained Limits
53 mm	99		1	
37.5 mm	98		1	
26.5 mm	94		4	
19 mm	89		4	
13.2 mm	80		9	
9.5 mm	75		6	
6.7 mm	69		5	
4.75 mm	64		5	
2.36 mm	55		9	
1.18 mm	47		8	
0.6 mm	38		9	
0.425 mm	32		6	
0.3 mm	24		8	
0.15 mm	17		8	
0.075 mm	12		4	

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven 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
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			



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**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131E  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** TP 3 @ 0-700



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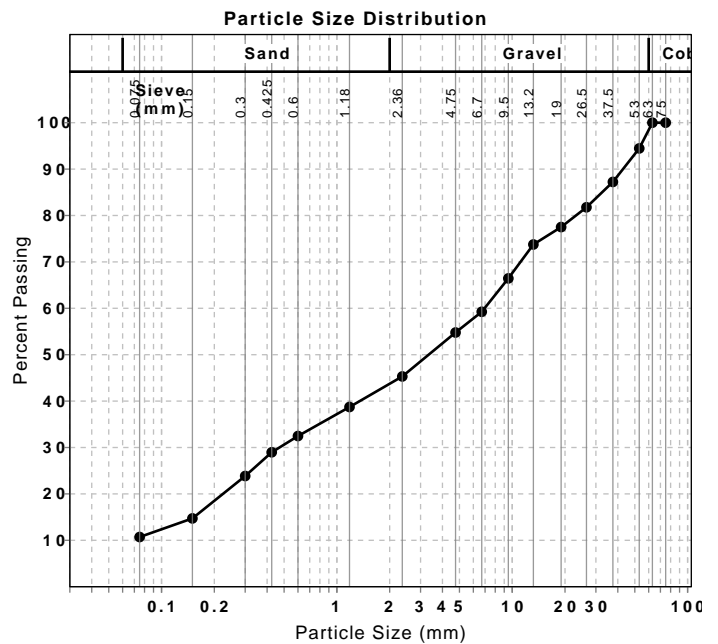


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Particle Size Distribution (AS1289 3.6.1)				
Sieve	Passed %	Passing Limits	Retained %	Retained Limits
75 mm	100		0	
63 mm	100		0	
53 mm	94		6	
37.5 mm	87		7	
26.5 mm	82		5	
19 mm	78		4	
13.2 mm	74		4	
9.5 mm	66		7	
6.7 mm	59		7	
4.75 mm	55		4	
2.36 mm	45		9	
1.18 mm	39		7	
0.6 mm	32		6	
0.425 mm	29		3	
0.3 mm	24		5	
0.15 mm	15		9	
0.075 mm	11		4	

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

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			



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**Project Location:** Broken Hill Hospital BROKEN HILL  
**Work Request:** 10131  
**Sample Number:** 233-10131F  
**Date Sampled:** 06/02/2023  
**Dates Tested:** 06/02/2023 - 24/02/2023  
**Sampling Method:** AS 1289.1.2.1 6.5.3 - Power auger drilling  
**Sample Location:** TP 4 @ 0-500



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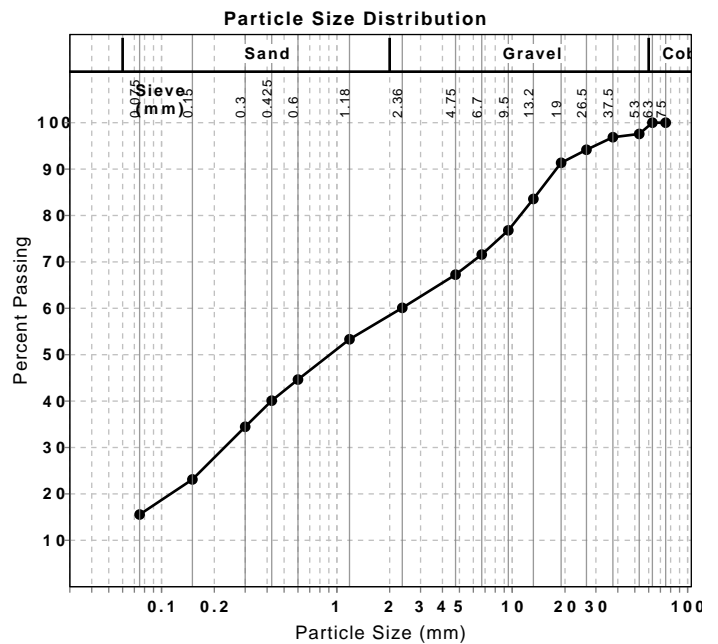


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 NATA Accredited Laboratory Number: 10784

Particle Size Distribution (AS1289 3.6.1)				
Sieve	Passed %	Passing Limits	Retained %	Retained Limits
75 mm	100		0	
63 mm	100		0	
53 mm	98		2	
37.5 mm	97		1	
26.5 mm	94		3	
19 mm	91		3	
13.2 mm	84		8	
9.5 mm	77		7	
6.7 mm	72		5	
4.75 mm	67		4	
2.36 mm	60		7	
1.18 mm	53		7	
0.6 mm	45		9	
0.425 mm	40		5	
0.3 mm	34		6	
0.15 mm	23		11	
0.075 mm	16		8	

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven 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
Moisture Condition Determined By	AS 1289.3.1.1 / AS 1289.3.1.2 / AS 1289.3.9.1 / AS 1289.3.9.2		
Linear Shrinkage (%)			
Cracking Crumbling Curling			



## **CERTIFICATE OF ANALYSIS 35845**

### **Client Details**

<b>Client</b>	Civil Test Pty Ltd
<b>Attention</b>	Civiltest Admin
<b>Address</b>	2/48 Tenth Street, Mildura, VIC, 3500

### **Sample Details**

<b>Your Reference</b>	<b><u>3230047</u></b>
<b>Number of Samples</b>	6 Soil
<b>Date samples received</b>	15/02/2023
<b>Date completed instructions received</b>	15/02/2023

### **Analysis Details**

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

**Please refer to the last page of this report for any comments relating to the results.**

### **Report Details**

<b>Date results requested by</b>	22/02/2023
<b>Date of Issue</b>	22/02/2023
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. <b>Tests not covered by NATA are denoted with *</b>	

#### **Results Approved By**

Chaminda Gunasekara, Inorganics Supervisor  
Chris De Luca, Assistant Lab Manager

#### **Authorised By**



Pamela Adams, Laboratory Manager

**Aggressivity in Soil**

Our Reference		35845-1	35845-2	35845-3	35845-4	35845-5
Your Reference	UNITS	BH 6 @ 1000	BH 6 @ 3500	TP 1 @ 0-600	TP 2 @ 0-900	TP 3 @ 0-700
Date Sampled		06/02/2023	06/02/2023	06/02/2023	06/02/2023	06/02/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date Extracted	-	17/02/2023	17/02/2023	17/02/2023	17/02/2023	17/02/2023
Date analysed	-	18/02/2023	18/02/2023	18/02/2023	18/02/2023	18/02/2023
pH 1:5 soil:water	pH Units	8.6	8.8	8.7	8.5	8.6
Electrical Conductivity 1:5 soil:water	µS/cm	430	96	1,000	1,500	580
Chloride, Cl 1:5 soil:water	mg/kg	37	<10	97	150	44
Sulphate, SO4 1:5 soil:water	mg/kg	840	60	2,600	4,400	1,000

**Aggressivity in Soil**

Our Reference		35845-6
Your Reference	UNITS	TP 4 @ 0-500
Date Sampled		06/02/2023
Type of sample		Soil
Date Extracted	-	17/02/2023
Date analysed	-	18/02/2023
pH 1:5 soil:water	pH Units	8.6
Electrical Conductivity 1:5 soil:water	µS/cm	640
Chloride, Cl 1:5 soil:water	mg/kg	46
Sulphate, SO4 1:5 soil:water	mg/kg	1,100

Moisture						
Our Reference		35845-1	35845-2	35845-3	35845-4	35845-5
Your Reference	UNITS	BH 6 @ 1000	BH 6 @ 3500	TP 1 @ 0-600	TP 2 @ 0-900	TP 3 @ 0-700
Date Sampled		06/02/2023	06/02/2023	06/02/2023	06/02/2023	06/02/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	17/02/2023	17/02/2023	17/02/2023	17/02/2023	17/02/2023
Date analysed	-	18/02/2023	18/02/2023	18/02/2023	18/02/2023	18/02/2023
Moisture	%	5.6	6.0	6.3	8.1	5.8

Moisture		
Our Reference		35845-6
Your Reference	UNITS	TP 4 @ 0-500
Date Sampled		06/02/2023
Type of sample		Soil
Date prepared	-	17/02/2023
Date analysed	-	18/02/2023
Moisture	%	6.1

Method ID	Methodology Summary
<b>Inorg-001</b>	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only as analysis outside of the APHA storage times.
<b>Inorg-002</b>	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
<b>Inorg-008</b>	Moisture content determined by heating at 105°C for a minimum of 12 hours.
<b>Inorg-081</b>	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110-B. Water samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Aggressivity in Soil					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	8.6	8.6	0	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	430	420	2	103	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	37	28	28	110	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	840	730	14	104	[NT]



## Result Definitions

<b>NT</b>	Not tested
<b>NA</b>	Test not required
<b>INS</b>	Insufficient sample for this test
<b>PQL</b>	Practical Quantitation Limit
<b>&lt;</b>	Less than
<b>&gt;</b>	Greater than
<b>RPD</b>	Relative Percent Difference
<b>LCS</b>	Laboratory Control Sample
<b>NS</b>	Not specified
<b>NEPM</b>	National Environmental Protection Measure
<b>NR</b>	Not Reported

## Quality Control Definitions

<b>Blank</b>	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
<b>Duplicate</b>	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
<b>Matrix Spike</b>	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
<b>LCS (Laboratory Control Sample)</b>	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
<b>Surrogate Spike</b>	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

## Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

## Report Comments

Samples received in good order: No attempt to cool

Unit 2 48 Tenth Street MILDURA VIC 3500 Telephone: 5023 2870  
Head Office: 10 Latham Street (P O Box 537) Mornington 3931 Tel: (03) 5975 6644 Fax: (03) 5975 9589  
Also at: Thomastown (03) 9874 5844, Albury (02) 6024 4343 and Perth (08) 9455 1152

## CIVILTEST PTY LTD

Soil Testing and Geotechnical Consultants.

TEST METHODS ; AS 1289 2.1.1. & 3.6.1.

## SITE INVESTIGATION LAB REVIEW.

### MILDURA LABORATORY.

SAMPLED BY / DATE:		WO	6/02/2023		Page 1 of 1	
TESTED BY:		AD				
CHECKED BY:		IC				
BALANCE:		9				
OVEN:		19				
REPORT NUMBER:		3230047				
CLIENT:		Health Infrastructure				
PROJECT:		Broken Hill Hospital BROKEN HILL				
BOREHOLE NUMBER:	1	1	4	6		
SAMPLE NO:						
DEPTHS: mm	0	200	0	0		
SAMPLE DESCRIPTION:	Fill Concrete Sand	Fill Broken rock bricks	Fill SAND silty	Fill Concrete Sand		
GPS POSITION *						
EASTING	Gray	Black Brown Red	Brown	trace silt		
NORTHING	Moist	Dry	Moist	Brown Gray		
	Medium Dence	Hard	Medium Dence	Moist Dence		
Penetrometer: kPa						
UNIFIED SOIL CLASS: **						
Moisture Content:	2.2%	25.5%	8.9%	8.2%		
CLAY AND SILT: -0.075mm	12.3%	26.0%	28.5%	40.2%		
FINE SAND: 0.075-0.425mm	17.1%	36.2%	42.0%	26.7%		
COARSE SAND: 0.425-2.36mm	20.2%	22.3%	14.8%	13.4%		
GRAVEL: +2.36mm	50.4%	15.5%	14.7%	19.7%		

\*\* Estimated on visual assessment only

\* GPS is approximate only