Two Wells SAAS Ambulance Station

Geotechnical Investigation Report

Grieve Gillett Architects

30 January 2025
Ref: 241697R002RevB

tonkin

Building exceptional
outcomes together

Document History and Status

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Contents

Project: Two Wells SAAS Ambulance Station | Geotechnical Investigation Report
Client: Grieve Gillett Architects
Ref: 241697R002RevB

Tables

Figures

Appendices

1 Introduction

South Australia Ambulance Services (SAAS) are still establishing the site location in Two Wells, SA. Tonkin has been engaged by the Grieve Gillett Architects to undertake the design of the proposed new ambulance station. As part of this design, a geotechnical investigation was conducted by Tonkin to understand the geotechnical properties of the site. Environmental testing was also conducted by Tonkin in conjunction with the geotechnical investigations.

1.1 Proposed Construction

The proposed construction of new ambulance station will consist of:

- 3 Bay Garage
- Training Room
- 10 External Car parks
- Entry and Exiting Crossovers
- Kitchen, Offices, Crew Room, Changeroom, Storeroom, Toilets and Sleep Rooms

1.2 Scope of Works

The scope of work was developed to confirm the ground profile and soil properties for the design of proposed ambulance station at two Wells. Prior to commencing fieldwork, a desktop review was carried out to understand the regional geotechnical conditions. The fieldwork took place on the 8th of January 2025, involving the following scope of site investigation works:

- Five boreholes were drilled using a 4WD-mounted Rockmaster Drill rig employing push tube methodology. Three boreholes were drilled to a target depth of 4.0 meters below ground level (mBGL) and two boreholes were drilled to a target depth of 1.5 mBGL. The locations were adjusted based on the presence of existing underground services.
- Dynamic Cone Penetrometer (DCP) tests were undertaken at all borehole locations to a target depth of 1.5 mBGL or refusal in accordance with AS 1289.6.3.2.
- The soil profile at each borehole location was logged by a Tonkin Geotechnical Engineer in accordance with AS 1726 Geotechnical site investigations.
- Soil samples were collected and submitted to a NATA accredited testing laboratory for a range of geotechnical testing.

A plan showing the borehole locations is shown in Figure 1.1.

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MetroMap, 2024

Grieve Gillett Architects

TWO WELLS SAAS AMBULANCE STATION
GEOTECHNICAL INVESTIGATION
BOREHOLE LOCATION PLAN

Figure 1.1

1.3 Desktop Review

The desktop review included accessing publicly available information from the South Australian Resources Information Gateway (SARIG)[1] and the Geoscience Australia's Stratigraphic Database[2].

1.3.1 Regional Geology

Our review of information available from the South Australian Resources Information gateway (SARIG) indicates that the investigated site is underlain by:

• Unit Qp\ca - Pleistocene calcrete – Pleistocene aged Undifferentiated Pleistocene calcrete.

Regional geology mapping from SARIG for the site is shown in Figure 1.2 below.

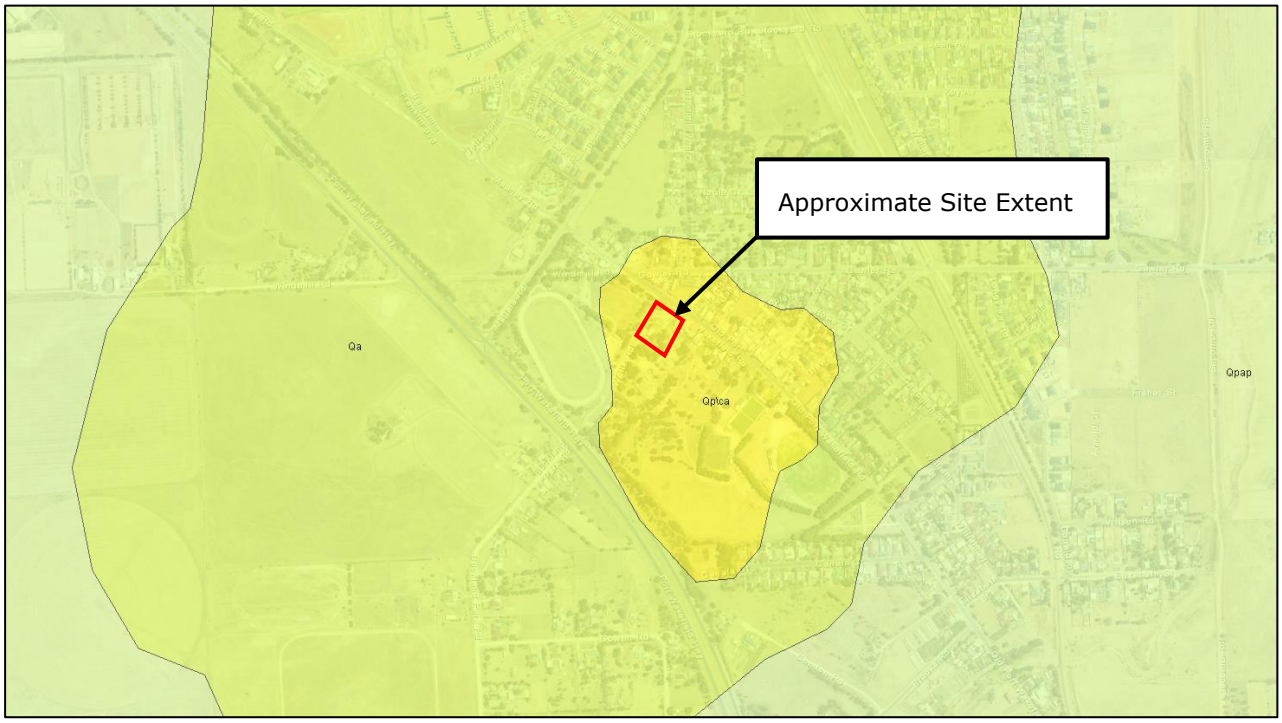


Figure 1.2 Regional Geology (SARIG, 2025)

1.3.2 Groundwater

According to groundwater information available through SARIG, shallow groundwater is expected to be encountered between 2 to 5 mBGL. A search on WaterConnect[3] shows 22 registered wells within 1km from the vicinity and 12 of them have Static Water Levels (SWL) ranging from 1.2 m to 8 m. A summary of these wells is provided in the Ground WaterConnect report in Appendix A.

[1] Department for Energy and Mining (2025). South Australian Resources Information Gateway (SARIG), Government of South Australia, Accessed 09 January 2025, https://map.sarig.sa.gov.au/

[2] Geoscience Australia and Australian Stratigraphy Commission (2017). Australian Stratigraphic Units Database, Commonwealth of Australia, Accessed 09 January 2025, https://asud.ga.gov.au/

[3] Department of Environment and Water (2025). *Groundwater Data Default,* accessed 09 January 2025, https://www.waterconnect.sa.gov.au/Systems/GD/Pages/Default.aspx

2 Site Conditions

2.1 Site Description

The site consists of a small shed and a sealed car park. The site slopes slightly towards the southwest, and medium to large trees are present on-site.

2.2 Geotechnical Investigation

2.2.1 Boreholes

Five boreholes (BH01 to BH05) were drilled using dynamic push tube methodology. Two boreholes (BH01 and BH03) were drilled to a depth of 4.0 mBGL and two boreholes (BH04 and BH05) were drilled to a depth of 1.5 mBGL. One borehole (BH02) was terminated at 1.0 mBGL due to push tube and solid auger refusal encountered within a calcrete layer. Borehole locations were selected away from existing services and placed at the proposed development site. The boreholes were drilled using a 4WD-mounted drill rig operated by Lab and Field.

A Geotechnical Engineer from Tonkin supervised the investigation full time. The recovered samples were logged in accordance with AS 1726 Geotechnical site investigations. Pocket Penetrometer tests were undertaken on competent cohesive soil samples recovered. The location of each borehole and the final depth is shown in Table 2.1.

Table 2.1 Summary of Borehole Locations

Borehole	Easting	Northing	Elevation (mAHD)	Depth (m)
BH01	271950.1	6169213.3	11.7	4.0*
BH02	271959.8	6169231.3	12.3	1.0R
BH03	271970.6	6169213.1	11.9	4.0*
BH04	271958.3	6169195.0	11.9	1.5*
BH05	271940.0	6169185.4	12.5	1.5*

Note: * = Extent of testing R = Refusal encountered

2.2.2 Stratigraphy

The subsurface conditions encountered during the investigation were in general agreement with the anticipated conditions following the desktop study.

A summary of the soils encountered and the depths in each borehole are presented in Table 2.2. Reference should be made to the individual borehole logs and core photographs presented in Appendix B.

Table 2.2 Soil Stratigraphy

Unit ID	Description	Depth to Underside of Unit (m)				
		BH01	BH02	BH03	BH04	BH05
1a	FILL. Asphalt/ Sandy Gravel, fine to coarse grained gravel, grey brown, fine to coarse grained sand	0.45	0.4	0.3	0.3	-
1b	TOPSOIL. Silty Sand, brown, fine to medium grained.	-	-	-	-	0.2
2	CALCRETE. recovered as Calcareous Sandy/Clayey Gravel/Gravelly Sand, pale grey brown, fine to coarse grained, with low plasticity silt.	1.1	1.0^{R}	1.1	1.0	1.1
3	Calcareous Sandy CLAY. low to medium plasticity, pale reddish brown, fine to coarse grained sand, with or trace fine to coarse grained gravel.	2.0		1.4	1.3	1.5*
4	CLAY. medium to high plasticity, red brown, trace fine to medium grained sand.	4.0*		4.0*	1.5*	

Note: * = Extent of testing R = Refusal encountered

2.2.3 Groundwater

No free groundwater was observed in any of boreholes.

2.3 In Situ Testing

2.3.1 Dynamic Cone Penetrometer (DCP) Testing

At all boreholes DCP testing was proposed to a target depth of 1.5 mBGL in accordance with the methodology outlined in AS 1289.6.3.2. Refusal was encountered at all boreholes prior to reaching the target depth due to the presence of the calcrete. DCP test logs can be found in Appendix B.

2.4 Laboratory Testing

Three samples including two bulk samples were collected from three boreholes during the investigations. Samples were submitted to NATA accredited laboratory Lab & Field. Select samples were analysed for particle size distribution, Atterberg limits and Soaked California Bearing Ratio (CBR). A summary of the laboratory testing undertaken is presented in Table 2.3. The laboratory test certificates are presented in Appendix C. References to the testing procedures adopted are shown on the laboratory certificates.

Table 2.3 Geotechnical Laboratory Results

Borehole	Sample Depth (mBGL)		Class	Particle Size Distribution (%)			Atterberg Limits				Soaked CBR	
	From	To		< 75 µm	> 75 µm, < 2.36 mm	> 2.36mm	LL (%)	PL (%)	PI (%)	LS (%)	CBR (%)	CBR Swell (%)
BH03	1.5	1.9	CI	91	9	0	43	14	29	14.5	-	-
BH04	0.5	1.0	GM	19	39	42	23	17	6	2.0	12	0.0
BH05	0.3	0.8	GM	-	-	-	-	-	-	-	40	0.5

3 Design Recommendations

3.1 Footing Design

3.1.1 Site Classification

3.1.1.1 Estimated Characteristic Surface Movement

The site has been classified in accordance with AS 2870 Residential Slabs and Footings. The estimated characteristic soil surface movement (ys) was calculated to be in between 20 to 30 mm. In accordance with Section 2 of AS 2870, the site has been classified as **Class M-D/P** due to the presence of calcareous soils and trees in the vicinity of the proposed construction.

Due to the presence of calcareous soils, design of the footings shall consider the requirements of AS 2870 and the recommendations of Special provisions for the design of residential slabs and footings and structural design of small structures, South Australian Conditions. In accordance with these recommendations, footings shall be designed to Class **H2-D** at a minimum.

All site classifications are based on current site conditions. They do not consider factors that produce abnormal moisture conditions such as:

- Future tree planting/removal
- Excessive or irregular watering adjacent to the structures
- Failure to provide and/or maintain adequate site drainage
- Irregular climatic effects including prolonged droughts and wet periods prior to construction

The classification of the site has not considered the effects of future site works (cut and fill), which may require site re-classification.

3.1.1.2 Earthquake Classification

AS 1170.4 Earthquake Actions in Australia details the requirements for consideration of the effects of earthquakes on proposed structures. The design is influenced by several factors, namely:

- Structure importance level, based on risk and consequence of failure (both in terms of risk to life and social/economic risk).
- The Hazard Factor, which varies for geographical location.
- The site Soil Sub-Class, based on the subsoil strength and thickness.

Based on the results of geotechnical investigations and the values in AS 1170.4 Table 3.3, the Soil Sub-Class for the site is defined as Class Ce – Shallow soil site.

3.1.2 Allowable Vertical Bearing Pressure

Based on our inspection, investigation, and test results, the minimum allowable bearing pressure to be used in shallow footing design is 100 kPa, on account of the dense to very dense calcrete layer encountered throughout the site. Footings shall not be found within fill or topsoil encountered during the investigation.

It is recommended that a qualified geotechnical engineer inspect the site during construction to confirm the above recommendations.

3.2 Pavement Design

A subgrade CBR recommendation has been made for any proposed pavement design within the investigated site. This recommendation has been made with consideration of the following information:

• Soaked CBR laboratory testing undertaken on bulk samples

• Correlations with Dynamic Cone Penetrometer (DCP) testing undertaken adjacent to each borehole in accordance with guidance from Austroads Guide to Pavement Technology Part 2: Pavement Structural Design.

The CBR test conducted on the BH04 soil sample indicates a CBR value of 12% 5 mm penetration, with all other estimated and tested CBR values being higher than this. Therefore, a design subgrade CBR of 10.0% is recommended for the design of the pavements founded on the natural calcrete layer.

The subgrade of any pavement construction shall be proof-rolled and compaction tested in accordance with AS 3798 to identify any areas of loose compaction. If any soft zones are encountered, a qualified geotechnical engineer shall be consulted to identify the appropriate remediation methodology.

4 Geotechnical Risks and Considerations

4.1 Presence of Fill

Fill was encountered in four boreholes (BH01 to BH04) to depths ranging between 0.3 to 0.45 mBGL. These boreholes were drilled in the existing car park, and the fill appears to consist of pavement materials. As no documentation of the construction of the fill is available, this fill must be treated as uncontrolled fill. Topsoil was encountered in one borehole (BH05) up to 0.2 mBGL. Topsoil and uncontrolled fill shall be removed prior to construction.
The recommendations herein have been made based upon the conditions encountered at the locations of the boreholes, and lesser or greater depths of fill may be present in other locations. Should conditions that differ from those detailed in this report be encountered during construction, advice should be sought from a suitably qualified and experienced geotechnical practitioner to establish suitable design parameters.

4.2 Collapsible Soils

Calcareous soils were encountered in all boreholes. These soils may be susceptible to a loss of strength upon wetting and are potentially collapsible. The design of structures shall consider the recommendations made in Special provisions for the design of residential slabs and footings and structural design of small structures, South Australian Conditions when designing any footings for structures at the site. Design of structures and pavements shall also consider diverting surface water away from structures and pavements to prevent subgrade soils being exposed to excessive moisture.

Construction must endeavour to prevent adverse moisture conditions occurring below pavements or structures to minimise the risk of soil collapse. Construction involving excavation should endeavour to leave excavations open for as short a time period as possible and surface water flows should be directed away from open excavations to minimise the possibility of adverse moisture conditions. If construction occurs during inclement weather, additional water control measures or shoring should be considered to avoid excessive wetting of calcareous soils. Timing of the construction of road box outs should consider weather conditions to prevent the formation of adverse moisture conditions that could lead to weakening of subgrade soils.

Additionally, non-calcareous soils on site are considered to be highly reactive in accordance with AS 2870. Excessive wetting of soils immediately adjacent to construction should be avoided to prevent accentuation of reactive shrink swell movements.

4.3 Excavatability

Indurated soils (Calcrete) were encountered at shallow depths at all borehole locations. In borehole BH02, Calcrete could not be drilled by the solid auger. Excavation with conventional earthmoving machinery is expected to be feasible within this harder indurated material, however buckets with rock teeth, and excavators with higher capacities may be required for excavation in these areas.

We expect the non-indurated soils encountered during the investigation to be readily excavated with conventional earthmoving machinery such as excavators, loaders and similar.

4.4 Excavation Stability

Batter slopes in the topsoil and fill materials should not exceed 1 vertical to 3 horizontal. These materials may be dry and flowable when unconfined and may not remain stable even at the recommended slope. Flatter batters or shoring may be required to ensure excavation stability in these materials. Formal management of excavations in these conditions will be required during construction, with the management probably involving stability assessment or the design of appropriate shoring by a suitably qualified geotechnical engineer.

Excavations within the stiff to very stiff clays are likely to experience stability of near vertical faces in the short term (nominally one day work), provided that excavations are not affected by adverse soil moisture conditions or loading at the crest.

As identified in Section 4.2, collapsible soils have been identified on site. Construction should endeavour to prevent water ingress into excavations to prevent collapse of collapsible soils. Should construction occur during wet weather, excavations in calcareous soils must be battered or supported by shoring or other support methodology designed by a qualified geotechnical engineer.

This advice shall consider the minimum benching requirements as required by the relevant occupational health and safety regulations.

4.5 Subgrade Preparation

At the site of proposed pavement construction, strip and grub to remove topsoil and uncontrolled fill and excavate as required to the excavation depth.

The subgrade of any pavement construction should be proof rolled and compaction tested in accordance with AS 3798 to identify any areas of loose compaction. While subgrade soils were recovered with stiff to hard consistency during investigations, care shall be taken during construction to avoid over wetting the subgrade (e.g. undertake compaction at or just below OMC).

4.6 Reuse of Excavated Materials

Non-calcareous soils encountered may be suitable for reuse as engineered fill provided that they are compliant with the project specification. Calcareous soils should not be reused as engineered fill.

5 Limitations

5.1 Scope

This report has been prepared in accordance with the scope of services agreed between Tonkin Consulting and the Client. In some circumstances, the scope of services may have been limited by a range of factors such as time, budget, access, site disturbance or other constraints.

5.2 Reliance on Data

In preparing the report Tonkin Consulting has relied upon data, surveys and other information provided by other sources. Unless otherwise stated in the report, Tonkin Consulting has not verified the accuracy or completeness of that data. To the extent that the statements, facts, opinions, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent on the accuracy and completeness of the data. Tonkin Consulting will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Tonkin Consulting.

5.3 Geotechnical Investigation

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared to meet specific needs and individual situations. A report prepared for one purpose may not be adequate or suitable for others.

This report was prepared for the Client and for the purposes indicated by the Client or its representative. Use by any other person, or by the Client for a different purpose, might result in problems. This report should not be used by anyone, including the Client, for other than its intended purpose without seeking additional geotechnical advice.

5.4 Project-Specific Factors

This report is based on investigations designed to address project-specific factors. Unless further geotechnical advice is obtained, this report cannot be used when the nature of the proposed development is changed, or the size, configuration, location, or orientation of any development component is amended.

This report applies only to the site investigated and not to adjoining sites.

5.5 Limitations of Investigations

This report is based on data collected at specific locations using specific investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of our Proposal and the Brief, and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement. Actual conditions could vary from the assumed model, as no subsurface exploration programme, no matter how extensive, can reveal all subsurface details and conditions.

The borehole logs are the subjective interpretation of subsurface conditions at particular locations, made by trained personnel. The interpretation maybe limited by the method of investigation and may not always be definitive. Observations of a test pit or excavation allows a greater area of the subsurface conditions to be inspected than borehole locations although such methods are limited by depth and site disturbance restrictions. In borehole investigations, the actual interface between materials maybe more gradual or abrupt than the report indicates.

5.6 Time Dependency

Subsurface conditions are subject to change over time by natural forces and man-made influences. A geotechnical report is based on the conditions that existing at the time of the subsurface investigations. A geotechnical engineer's advice should be sought as to whether the report's conclusions remain valid.

5.7 Involvement during design and construction

A geotechnical engineer should be retained to work with other appropriate design professionals to explain the relevant geotechnical finding and review the adequacy of their plans and specifications relative to geotechnical issues.

Issues relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

5.8 Whole report

This report is intended to be read as a whole. Parts of the report should not be separated out and used without reference to the whole of the report.

In particular borehole and excavation logs should not be redrawn or used in isolation from the report.

5.9 Report for the Benefit of the Client

This report has been prepared for the benefit of the Client and no other party. Tonkin Consulting assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Tonkin Consulting or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this report. Other parties should not rely on the report or the accuracy or completeness of any conclusion and should make their own enquiries and obtain independent advice in relation to such matters.

5.10 Other Limitations

Tonkin Consulting will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Appendix A – Registered Ground Water wells

WaterConnect

Groundwater Data Report

Government of South Australia
Department for Environment and Water

Circle Centre -34.593611,138.513472, Radius 1km

Unit No	Date	Max Depth (m)	Latest Depth (m)	Status	Cased To (m)	SWL (m)	SWL Date	Yield (L/sec)	Yield Date	TDS (mg/L)	TDS Date	Aquifer	Purpose	Obs No	Permit No	SWL Status	Salinity Status
6628-549	01/01/1962	42.67	42.67	ABD													
6628-550	24/01/1949	24.38	24.38	NL	24.38	5.49	24/01/1949	0.38	24/01/1949	2285	24/01/1949	Qpah					
6628-585	20/01/1949	4.57	0	BKF		3.05	20/01/1949	0.13	20/01/1949	3099	20/01/1949	Qpah	STK				
6628-586	01/01/1920	60.96	60.96	ABD	60.96	6.1	13/03/1967	0.63	21/03/1962	2970	21/03/1962	Tomw(T1)	IRR	PTG041			
6628-587	09/10/1959	60.96	0	BKF				0.63	01/01/1963	4585	30/10/1964	Tomw(T1)	IRR		66172		
6628-588	01/10/1959	60.96	60.96	BLK		7.97	25/09/1998	13.89	16/04/1974	2870	09/10/1959	Tomw(T1)	OBS	PTG067		H	N
6628-593	21/01/1949	29.26	29.26	ABD	29.26	2.74	21/01/1949	1.26	21/01/1949	3582	26/08/1949	Qpah	IRR				
6628-594	21/01/1949	3.05		NL	3.05	1.22	21/01/1949	0.13	21/01/1949	3584	21/01/1949	Qpah	IRR				
6628-595	12/02/1968	19.51	19.51	OPR				0.25	12/02/1968	7515	12/02/1968	Qpah	IRR				
6628-761		38	38	OPR				0.19	29/03/1967	4500	06/03/1969	Qpah	DOM				
6628-763				NL													
6628-853	30/05/1967	36.58	0	BKF		8.23	30/05/1967	6.32	30/05/1967	7445	01/06/2002	Qpah(Q4)	DOM		502102		
6628-854				NL		0	21/01/1949			2258	21/01/1949	Tomw(T1)	IRR				
6628-855				NL						2230	08/04/1958						
6628-856				NL		0	31/01/1949			2744	31/01/1949	Tomw(T1)	STK				
6628-8789	05/11/1982	6	6	OPR								Qpah					
6628-12162	14/01/1983	27.5	27.5	OPR	27.5			1	14/01/1983	4117	14/01/1983	Qpah(Q3)	IND		92448		
6628-27409		7.5	7.5		4.5	5.1	27/05/2014					Qpah	INV		232435		
6628-27410	27/05/2014	12	12		6	6.66	27/05/2014					Qpah	INV		232436		
6628-33058	08/05/2024	10.5	10.5		6.5	5.6	08/05/2024						INV		501279		
6628-33059	07/05/2024	11	11		7	5.8	07/05/2024						INV		501278		
6628-33060	08/05/2024	8	8		5	3.2	08/05/2024								501280		

22 records

Appendix B – Borehole Logs & Core Photographs

ENGINEERING BOREHOLE LOG

Borehole No: **BH01**

Client:	Grieve Gillett Architects	**Total Depth (mBGL):**	4	**Commenced:**	08/01/2025
Project:	Two Wells Ambulance Station	**Elevation (mAHD):**	11.71	**Completed:**	08/01/2025
Project No:	241697	**Easting:**	271950.19	**Logged By:**	LA
Contractor:	Lab + Field	**Northing:**	6169213.33	**Checked By:**	JNB
Equipment:	Rockmaster	**Coordinates:**	54		

Method	Elevation (m)	Water	Depth (m)	Graphic Log	Group Symbol	Material Description	Moisture	Consistency/ Density	Sample Interval	Samples	DCP (0 5 10 15 20 25)	Field Tests	Comments / Observations
SA	12					ASPHALT. (40mm)							
						FILL. Sandy GRAVEL. pale brown, fine to coarse sized, fine to coarse grained sand, trace low plasticity silt.	D	D		0.05 - 0.2 m ENV QC1			
PT			0.50		GC	Calcareous Clayey GRAVEL. low to medium plasticity clay, pale grey brown, fine to coarse sized, with fine to coarse grained sand.		D-VD		0.5 - 0.6 m ENV			Calcrete Layer
	11		1										
					CL-CI	Calcareous Sandy CLAY. low to medium plasticity, pale reddish brown, fine to coarse grained sand, with fine to coarse sized gravel, inorganic.	M-D	VSt		1.1 - 1.2 m ENV		1.5, PP 600	
			1.50										
					CL-CI	Calcareous Sandy CLAY. low to medium plasticity, pale reddish brown, fine to coarse grained sand, trace fine to coarse sized gravel.	w < PL			1.7 - 1.8 m ENV			
	10		2										
					CI	CLAY. medium plasticity, red brown, trace fine to medium grained sand, inorganic.				2 - 2.1 m ENV			
			2.50										
	9		3									3, PP 600	
					CI	CLAY. medium plasticity, red brown mottled pale grey, with fine to medium grained sand, inorganic.							With calcareous pockets
			3.50										
	8					**BH01 Target Depth Reached at 4m (Target Depth Reached)**							

Photo description	BH01		
Client	Grieve Gillett Architects		
Location	120 Port Wakefield Hwy, Two Wells SA 5501, Australia		
Project name	Two Wells Ambulance Station		
Project No	241697	**Scale**	Not to Scale
BH No	BH01	**BH Depth**	CorePhoto

ENGINEERING BOREHOLE LOG

Borehole No: **BH02**

Client:	Grieve Gillett Architects	**Total Depth (mBGL):**	1	**Commenced:**	08/01/2025
Project:	Two Wells Ambulance Station	**Elevation (mAHD):**	12.33	**Completed:**	08/01/2025
Project No:	241697	**Easting:**	271959.81	**Logged By:**	LA
Contractor:	Lab + Field	**Northing:**	6169231.33	**Checked By:**	JNB
Equipment:	Rockmaster	**Coordinates:**	54		

Method	Elevation (m)	Water	Depth (m)	Graphic Log	Group Symbol	Material Description	Moisture	Consistency/ Density	Sample Interval	Samples	DCP (0 5 10 15 20 25)	Field Tests	Comments / Observations
SA	12					ASPHALT. (40mm)							
						FILL. Sandy GRAVEL. grey brown, fine to coarse sized, fine to coarse grained sand.	D	VD		0.1 - 0.2 m ENV			
										0.3 - 0.4 m ENV	8		
			0.50			Calcareous Sandy GRAVEL. pale grey brown, fine to coarse sized, fine to coarse grained sand.				0.5 - 0.6 m ENV	12		Calcrete layer_ @1.0 both push tube and auger refusal
					GW			D-VD					
										0.9 - 1 m ENV			
						BH02 refusal Encountered at 1m (Push tube and Auger Refusal)							

Photo description	BH02		
Client	Grieve Gillett Architects		
Location	120 Port Wakefield Hwy, Two Wells SA 5501, Australia		
Project name	Two Wells Ambulance Station		
Project No	241697	**Scale**	Not to Scale
BH No	BH02	**BH Depth**	CorePhoto

ENGINEERING BOREHOLE LOG

Borehole No: **BH03**

Client:	Grieve Gillett Architects	**Total Depth (mBGL):**	4	**Commenced:**	08/01/2025
Project:	Two Wells Ambulance Station	**Elevation (mAHD):**	11.91	**Completed:**	08/01/2025
Project No:	241697	**Easting:**	271970.59	**Logged By:**	LA
Contractor:	Lab + Field	**Northing:**	6169213.15	**Checked By:**	JNB
Equipment:	Rockmaster	**Coordinates:**	54		

Method	Elevation (m)	Water	Depth (m)	Graphic Log	Group Symbol	Material Description	Moisture	Consistency/ Density	Sample Interval	Samples	DCP (0 5 10 15 20 25)	Field Tests	Comments / Observations
SA	12					FILL. Sandy GRAVEL. grey brown, fine to coarse sized, fine to coarse grained sand, trace low plasticity silt.	D	D-VD		0 - 0.2 m ENV QC2			
SA	11		0.50		GM	Calcareous Sandy GRAVEL. pale grey brown, fine to coarse sized, fine to coarse grained sand, with low plasticity silt.		VD		0.3 - 0.4 m ENV	DCP Refusal at 0.5m and Resatrted at 1.2m		Calcrete layer
PT			1		CL-CI	Calcareous Sandy CLAY. low to medium plasticity, pale reddish brown, fine to coarse grained sand, trace fine to medium sized gravel.	w < PL	VSt		1.1 - 1.2 m ENV	8 8 6 6		
PT	10		1.50		CI	CLAY. medium plasticity, red brown, trace fine to medium grained sand, inorganic.				1.4 - 1.5 m ENV			
PT			2							1.5 - 1.9 m GEO PI+PSD		1.8, PP 600	
PT	9		2.50										
PT			3									3, PP 600	
PT			3.50										
PT	8					**BH03 Target Depth Reached at 4m (Target Depth Reached)**							

tonkin

Photo description	BH03		
Client	Grieve Gillett Architects		
Location	120 Port Wakefield Hwy, Two Wells SA 5501, Australia		
Project name	Two Wells Ambulance Station		
Project No	241697	**Scale**	Not to Scale
BH No	BH03	**BH Depth**	CorePhoto

ENGINEERING BOREHOLE LOG

Borehole No: **BH04**

Client:	Grieve Gillett Architects	**Total Depth (mBGL):**	1.5	**Commenced:**	08/01/2025
Project:	Two Wells Ambulance Station	**Elevation (mAHD):**	11.86	**Completed:**	08/01/2025
Project No:	241697	**Easting:**	271958.29	**Logged By:**	LA
Contractor:	Lab + Field	**Northing:**	6169195.03	**Checked By:**	JNB
Equipment:	Rockmaster	**Coordinates:**	54		

Method	Elevation (m)	Water	Depth (m)	Graphic Log	Group Symbol	Material Description	Moisture	Consistency/ Density	Sample Interval	Samples	DCP (0 5 10 15 20 25)	Field Tests	Comments / Observations
SA	12					FILL. Sandy GRAVEL. grey brown, fine to coarse sized, fine to coarse grained sand, with low plasticity silt.	D	D		0.1 - 0.2 m ENV			
PT						Calcareous Sandy to Silty GRAVEL. pale grey brown, fine to coarse sized, fine to coarse grained sand.				0.3 - 0.4 m ENV	11 11		
			0.50		GM			D-VD		0.5 - 1 m BULK CBR+PI+PSD			Calcrete layer
	11		1		CL-CI	Calcareous Sandy CLAY. low to medium plasticity, pale reddish grey brown, fine to coarse grained sand, trace fine to coarse sized gravel, inorganic.	w < PL	VSt		1 - 1.1 m ENV			
					CI	CLAY. medium plasticity, red brown, trace fine to medium grained sand, inorganic.	w < PL			1.3 - 1.4 m ENV		1.3, PP 600	
						BH04 Target Depth Reached at 1.5m (Target Depth Reached)							

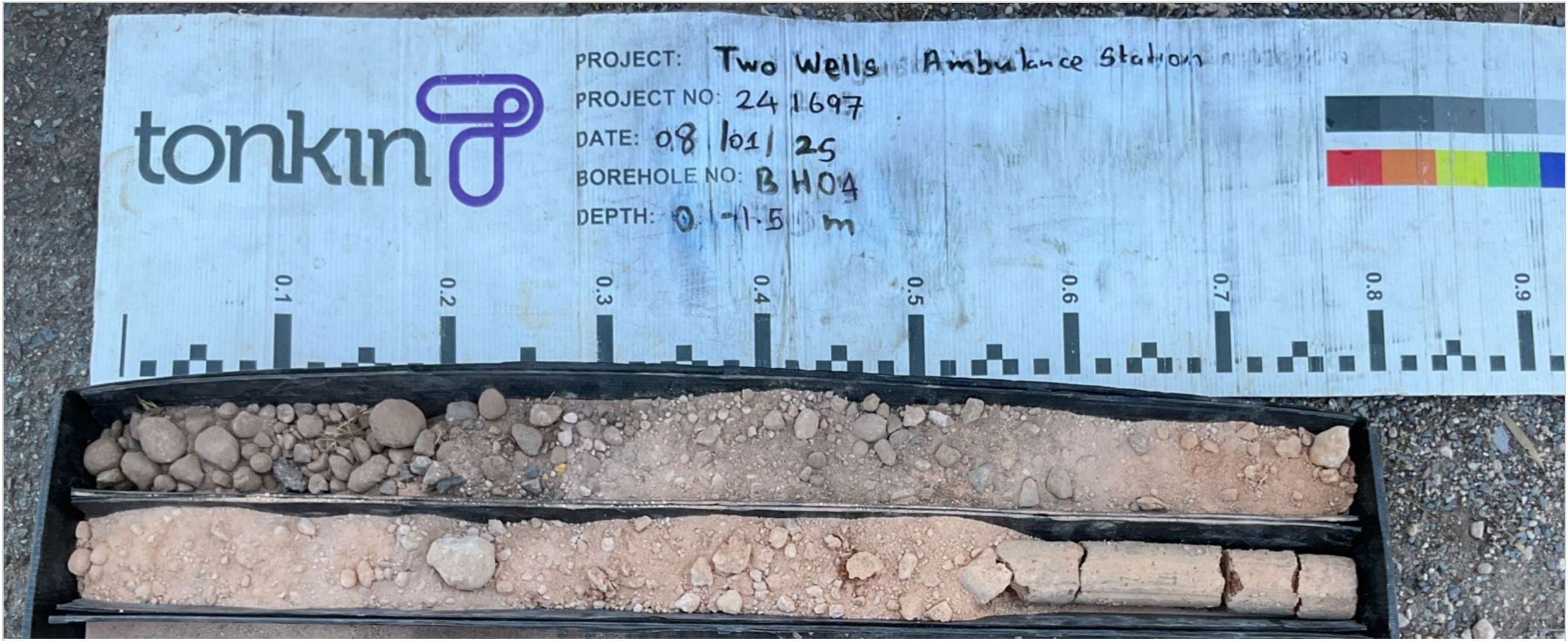


Photo description	BH04		
Client	Grieve Gillett Architects		
Location	120 Port Wakefield Hwy, Two Wells SA 5501, Australia		
Project name	Two Wells Ambulance Station		
Project No	241697	**Scale**	Not to Scale
BH No	BH04	**BH Depth**	CorePhoto

ENGINEERING BOREHOLE LOG

Borehole No: **BH05**

Client:	Grieve Gillett Architects	**Total Depth (mBGL):**	1.5	**Commenced:**	08/01/2025
Project:	Two Wells Ambulance Station	**Elevation (mAHD):**	12.49	**Completed:**	08/01/2025
Project No:	241697	**Easting:**	271940.08	**Logged By:**	LA
Contractor:	Lab + Field	**Northing:**	6169185.40	**Checked By:**	JNB
Equipment:	Rockmaster	**Coordinates:**	54		

Method	Elevation (m)	Water	Depth (m)	Graphic Log	Group Symbol	Material Description	Moisture	Consistency/ Density	Sample Interval	Samples	DCP (0 5 10 15 20 25)	Field Tests	Comments / Observations
PT	12				TS	Topsoil. Silty SAND. brown, fine to medium grained.	D	MD		0 - 0.1 m ENV	3, 4		
			0.50		GM	Calcareous Sandy GRAVEL. pale grey brown, fine to coarse sized, fine to coarse grained sand, with low plasticity silt.		D-VD		0.2 - 0.4 m ENV QC3 0.3 - 0.8 m BULK CBR 0.8 - 0.9 m ENV	17, 13		Calcrete Layer
	11		1		CL-CI	Calcareous Sandy CLAY. low to medium plasticity, pale grey brown, fine to coarse grained sand, trace fine to medium sized gravel, inorganic.	w < PL	St-VSt		1.2 - 1.4 m ENV			
						BH05 Target Depth Reached at 1.5m (Target Depth Reached)							

Photo description	BH05		
Client	Grieve Gillett Architects		
Location	120 Port Wakefield Hwy, Two Wells SA 5501, Australia		
Project name	Two Wells Ambulance Station		
Project No	241697	**Scale**	Not to Scale
BH No	BH05	**BH Depth**	CorePhoto

Appendix C – Laboratory Test Certificates

LAB AND FIELD PTY LTD

ABN 12 113 330 073
30 HUDSON ROAD
MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

CONSTRUCTION MATERIAL TESTING

Aggregate/Soil Test Report

Report No: MAT:PR-25/0016-1
Issue No: 1
This report replaces all previous issues of report no 'MAT:PR-25/0016-1'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No:

TRN:

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

Approved Signatory: Ward Bricker (Senior Laboratory Technician)

Date of Issue: 28/01/2025

Sample Details

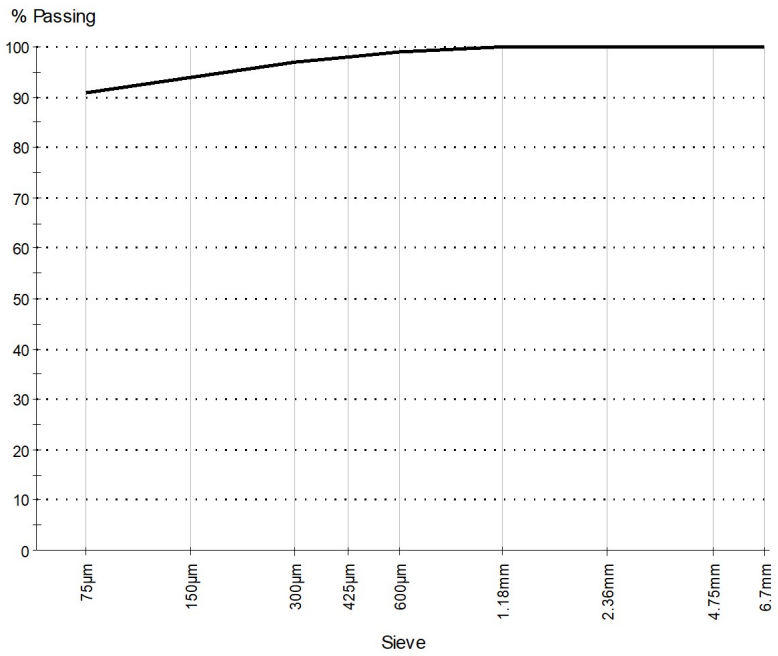
Sample ID:	PR-25/0016-1
Lot No.:	
Client Sample ID:	
Date Received:	8/01/2025
Date Sampled:	8/01/2025
Source:	On site
Material:	Soil Investigation Sample
Specification:	Soil Investigation Sample
Location:	BH03 1.5 - 1.9
Sampling Method:	AS1289.1.2.1 (6.5.2) Hand Auger Drilling
Sampled From:	Bore Hole

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	14.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.2	43	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	29	

Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven



Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	99	
425µm	98	
300µm	97	
150µm	94	
75µm	91	

Comments

N/A

LAB AND FIELD PTY LTD

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MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

CONSTRUCTION MATERIAL TESTING

Aggregate/Soil Test Report

Report No: MAT:PR-25/0016-2
Issue No: 1
This report replaces all previous issues of report no 'MAT:PR-25/0016-2'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No:

TRN:

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

Approved Signatory: Ward Bricker (Senior Laboratory Technician)

Date of Issue: 28/01/2025

Sample Details

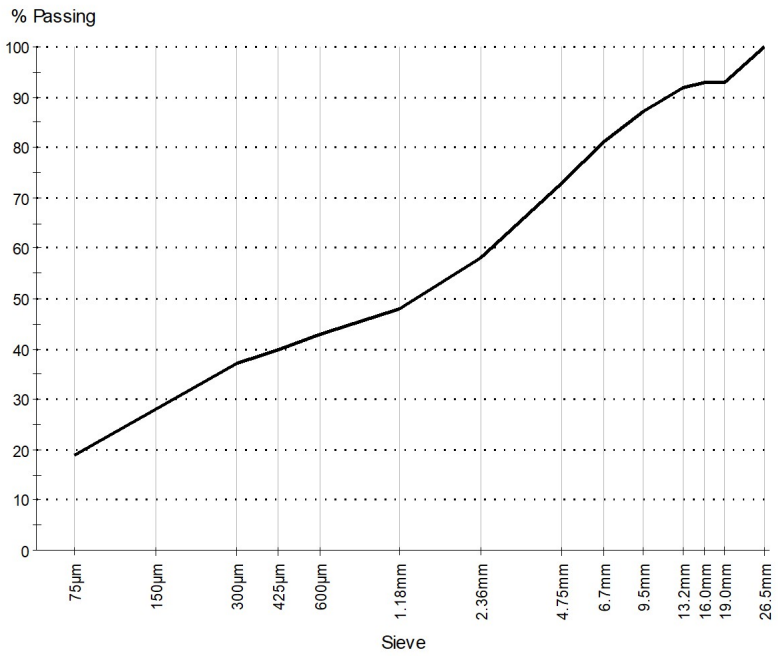
Sample ID:	PR-25/0016-2
Lot No.:	
Client Sample ID:	BH04 0.5 - 1.0
Date Received:	8/01/2025
Date Sampled:	8/01/2025
Source:	On site
Material:	Soil Investigation Sample
Specification:	Soil Investigation Sample
Location:	BH04 0.5 - 1.0
Sampling Method:	AS1289.1.2.1 (6.5.2) Hand Auger Drilling
Sampled From:	

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	2.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.2	23	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	6	

Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven



Note: Sample Washed

Sieve Size	% Passing	Limits
26.5mm	100	
19.0mm	93	
16.0mm	93	
13.2mm	92	
9.5mm	87	
6.7mm	81	
4.75mm	73	
2.36mm	58	
1.18mm	48	
600µm	43	
425µm	40	
300µm	37	
150µm	28	
75µm	19	

Comments

N/A

LAB AND FIELD PTY LTD

ABN 12 113 330 073
30 HUDSON ROAD
MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

CONSTRUCTION MATERIAL TESTING

California Bearing Ratio Test Report

Report No: CBR:PR-25/0016-2
Issue No: 1
This report replaces all previous issues of report no 'CBR:PR-25/0016-2'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No:

TRN:

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

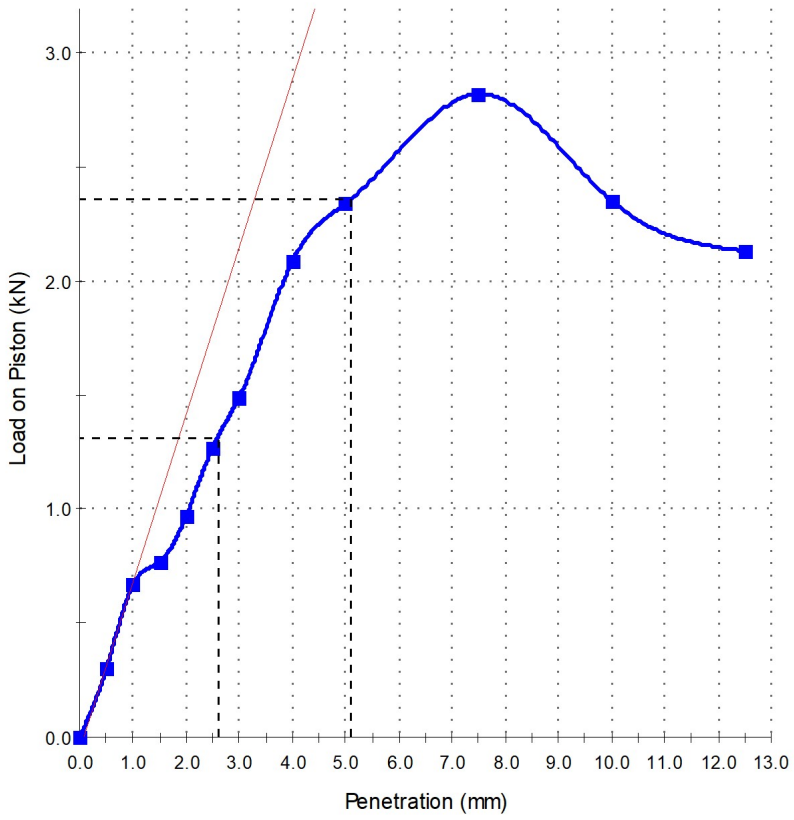
Approved Signatory: Steve Waters (Senior Soil Technician)

Date of Issue: 24/01/2025

Sample Details

Sample ID:	PR-25/0016-2	**Date Sampled:**	8/01/2025
Client Sample ID:	BH04 0.5 - 1.0		
Field Sample ID:		**Sampled By:**	submitted by Client
Sampling Method:	AS1289.1.2.1 (6.5.2) Hand Auger Drilling		
Source:	On site	**Material:**	Soil Investigation Sample
Specification:	Soil Investigation Sample	**Location:**	BH04 0.5 - 1.0
Tested By:	Jordan Michalanney	**Date Tested:**	17/01/2025

Load vs Penetration



Test Results

AS 1289.6.1.1 - 2017

CBR at 5.0mm (%):	**12**
Dry Density before Soaking (t/m³):	1.91
Density Ratio before Soaking (%):	98.0
Moisture Content before Soaking (%):	10.8
Moisture Ratio before Soaking (%):	95.5
Dry Density after Soaking (t/m³):	1.90
Density Ratio after Soaking (%):	98.0
Swell (%):	0.0
Moisture Content of Top 30mm (%):	16.0
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	48
Plasticity Determination Method:	AS 1289.3.1.2

Comments

LAB AND FIELD PTY LTD

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MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

LAB+Field
CONSTRUCTION MATERIAL TESTING

Maximum Dry Density Test Report

Report No: MDD:PR-25/0016-2
Issue No: 1
This report replaces all previous issues of report no 'MDD:PR-25/0016-2'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No:

TRN:

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

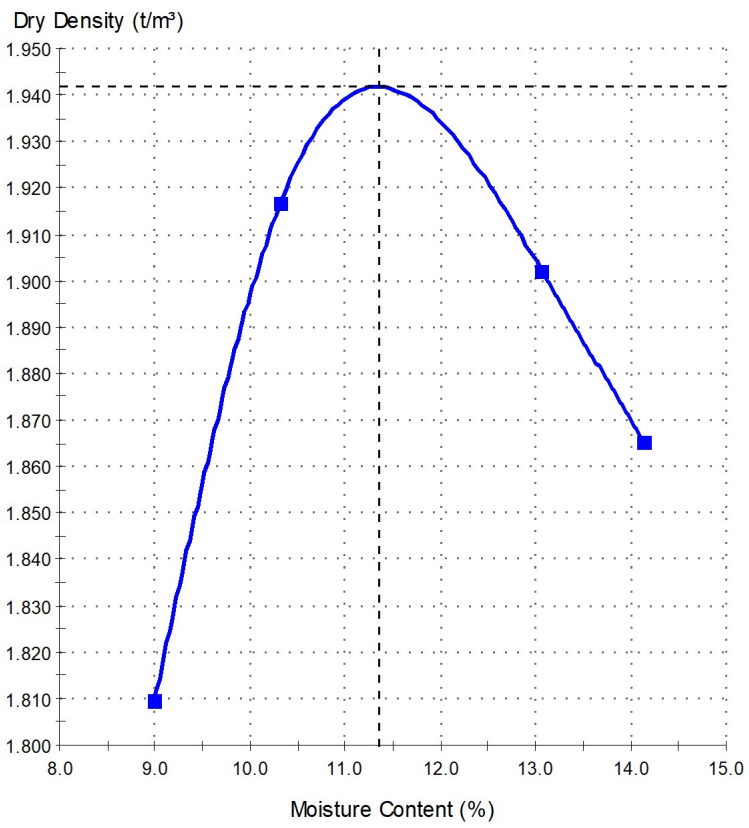
Approved Signatory: Steve Waters (Senior Soil Technician)

Date of Issue: 24/01/2025

Sample Details

Location: BH04 0.5 - 1.0
Sample ID: PR-25/0016-2
Client Sample ID: BH04 0.5 - 1.0
Field Sample ID:
Date Sampled: 8/01/2025
Sampling Method: AS1289.1.2.1 (6.5.2) Hand Auger Drilling
Source: On site
Material: Soil Investigation Sample
Specification: Soil Investigation Sample

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1 - 2017

Standard MDD (t/m³):	**1.94**
Standard OMC (%):	**11.5**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	24
LL Method:	AS 1289.3.1.2

Comments

LAB AND FIELD PTY LTD

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MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

CONSTRUCTION MATERIAL TESTING

California Bearing Ratio Test Report

Report No: CBR:PR-25/0016-3
Issue No: 1
This report replaces all previous issues of report no 'CBR:PR-25/0016-3'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

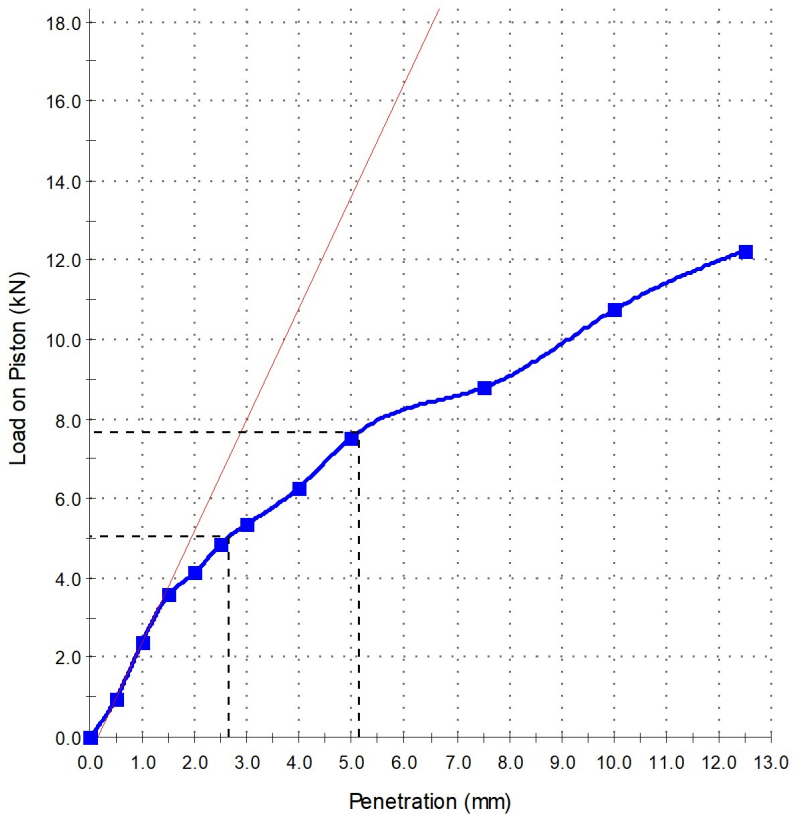
Approved Signatory: Steve Waters (Senior Soil Technician)

Date of Issue: 24/01/2025

Sample Details

Sample ID:	PR-25/0016-3	**Date Sampled:**	8/01/2025
Client Sample ID:	BH05 0.3 - 0.8		
Field Sample ID:		**Sampled By:**	submitted by Client
Sampling Method:	AS1289.1.2.1 (6.5.2) Hand Auger Drilling		
Source:	On site	**Material:**	Soil Investigation Sample
Specification:	Soil Investigation Sample	**Location:**	BH05 0.3 - 0.8
Tested By:	Jordan Michalanney	**Date Tested:**	17/01/2025

Load vs Penetration



Test Results

AS 1289.6.1.1 - 2017

CBR at 5.0mm (%):	**40**
Dry Density before Soaking (t/m³):	1.87
Density Ratio before Soaking (%):	98.5
Moisture Content before Soaking (%):	9.4
Moisture Ratio before Soaking (%):	76.5
Dry Density after Soaking (t/m³):	1.86
Density Ratio after Soaking (%):	98.0
Swell (%):	0.5
Moisture Content of Top 30mm (%):	15.8
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	24

Comments

LAB AND FIELD PTY LTD

ABN 12 113 330 073
30 HUDSON ROAD
MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

Maximum Dry Density Test Report

Report No: MDD:PR-25/0016-3
Issue No: 1
This report replaces all previous issues of report no 'MDD:PR-25/0016-3'.

Client: Tonkin Consulting
Level 2, 170 Frome St,
Adelaide SA 5000

Project No.: PR-25/0016

Project: Two Wells Amublance Station

Lot No:

TRN:

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 375

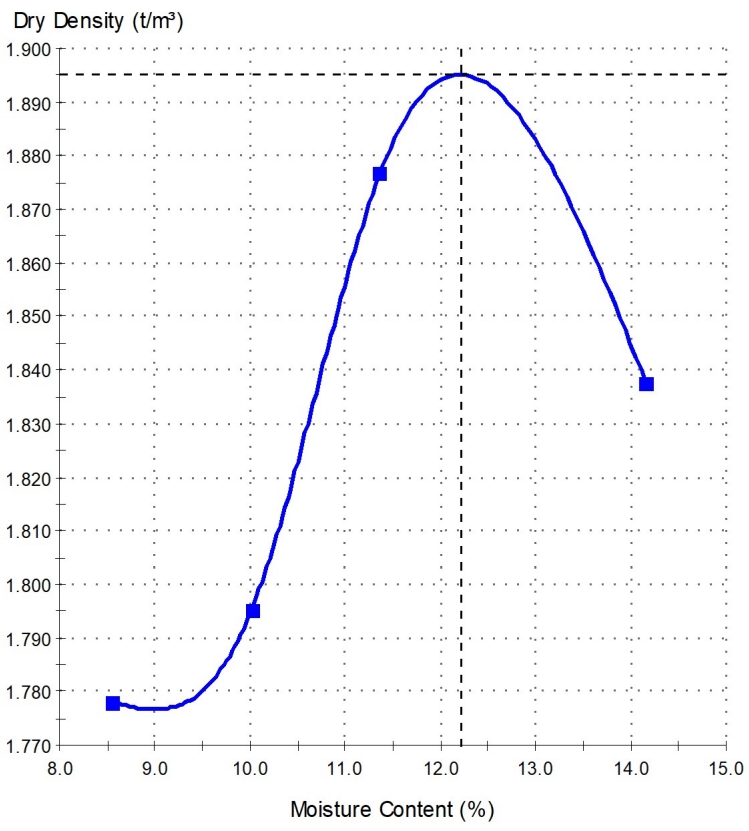
Approved Signatory: Steve Waters (Senior Soil Technician)

Date of Issue: 24/01/2025

Sample Details

Location: BH05 0.3 - 0.8
Sample ID: PR-25/0016-3
Client Sample ID: BH05 0.3 - 0.8
Field Sample ID:
Date Sampled: 8/01/2025
Sampling Method: AS1289.1.2.1 (6.5.2) Hand Auger Drilling
Source: On site
Material: Soil Investigation Sample
Specification: Soil Investigation Sample

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1 - 2017

Standard MDD (t/m³):	**1.90**
Standard OMC (%):	**12.0**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	24
LL Method:	Visual / Tactile

Comments