GEOTECHNIQUE® PTY LTD

ABN 64 002 841 063

Job No: 14305/11
Our Ref: 14305/11-AA-R3
12 August 2022

Mirvac Homes (NSW) Pty Ltd
C/- Calibre Professional Services Pty Ltd

Attention: Mr C Naoum

Dear Sir

re **Proposed Pedestrian bridge**
Stage 1 and Stages 2-4 Station Street, Menangle
Report on Geotechnical Investigation

We understand from the email and drawings received on 12 July 2022 that the proposed pedestrian bridge will be moved 2m towards the northern side (Ref. B1849 D102, Rev P1, Prepared by Bridge Design Pty Ltd) from the previously identified location (Ref. B1849 D02, Rev A). In this regard, we are pleased to update our report. The investigation was carried out as per our fee proposal Q14305-10, dated 9 April 2021 and was approved by Mr T Foster of Calibre Group in an email dated 14 April 2021.

Proposed Development
We understand that it is proposed to construct a standalone pedestrian bridge at the above site.

In this regard, a geotechnical investigation was required to determine existing subsurface conditions at the site and provide geotechnical recommendations necessary for the design of the proposed bridge.

Field Work
Field work for the investigation was conducted on 10 and 11 May 2021 and the following was completed:

- Reviewing available geological information relevant to the site.
- OH&S and walkover survey to assess existing site conditions.
- Reviewing services plans obtained from “Dial Before You Dig” to determine locations of services across the site.
- Scanning borehole locations for underground services to ensure that services were not damaged during field work. We engaged a specialist services locator for this purpose.
- Drilling two boreholes (BH1 and BH2) at each abutment location to depths of 14.5m, using a track mounted drilling rig. Boreholes were initially drilled to V/TC bit refusal and then cored to recover rock cores. Engineering logs and borehole locations plan (Drawing No 14305/10-AA2) are attached to the report.

- Conducting Standard Penetration Tests (SPT) at regular depth intervals in the boreholes to assess strength characteristics of sub-surface soils.
- Recovering representative soil and rock samples for visual assessment and laboratory tests (aggressivity and point load strength index).
- Measuring depths to groundwater level or seepage in the drilled boreholes, where encountered.

Field work was supervised by a Field Engineer from this company who was responsible for nominating borehole locations, supervision of in-situ tests, sampling and preparation of field logs.

Regional Geology

Reference to the Geological Map of Wollongong - Port Hacking (scale 1:100,000) indicates that the bedrock at the site belongs to Ashfield Shale and comprises dark grey to black shale and laminite.

Reference to the Soil Landscape Map of Wollongong - Port Hacking (scale 1:100,000) indicates that the landscape at the site belongs to Theresa Park Group, which is characterised by gently undulating slopes, mostly less than 5%, on Tertiary and Quaternary flood plains and terraces of Nepean River south of Cobbitty Creek. Soils in this landscape are highly variable and include poorly structured orange to red silty loam. The landscape is susceptible to localised flooding, seasonal water logging, very high erosion and concentrated flows.

Site Conditions

The site was inspected by an environmental scientist during the fieldwork. The site for the proposed pedestrian bridge consists primarily of the road shoulder and is bordered by rail corridor land with a corridor entrance and steep batter on the west side of the tracks. A guard rail was observed on the north shoulder of the station street bridge side and a vacant shoulder on the eastern side of the tracks.

Subsurface Conditions

Subsurface conditions encountered in the boreholes are detailed in the attached engineering logs and summarised below in Table 1.

Table 1 : Subsurface Conditions

BH	Top RL (AHD)	Terminated Depth (m)	AC/Seal (mm)	Roadbase Gravel (mm)	Fill (m)	Natural (m)	Bedrock (m)
1	91.54	14.5	20	200	0.22 – 1.85	1.85 – 2.3	2.3 –> 14.5
2	91.76	14.6	20	200	0.22 – 1.0	1.0 – 1.7	1.7 –> 14.6

Fill	Silty Clay, low plasticity, grey, with shale gravel
Natural	Silty CLAY, high plasticity, red
Bedrock	SHALE/SILTSTONE, grey, extremely weathered grading to slightly weathered with depth, extremely low strength grading to high strength with depth

Standard Penetration Tests conducted in the boreholes indicated the fill material to be well compacted and natural clayey soils to be stiff to hard in consistency.

Groundwater Conditions

Groundwater/seepage was not encountered to the auger refusal depths of the boreholes. Use of water for coring purposes precluded further measurements. It should be noted that groundwater levels generally vary due to changes in rainfall, temperature and other factors not evident during drilling.

Laboratory Testing

Chemical Tests

Soil samples recovered from the boreholes were tested to determine pH and sulphate and chloride contents, in the NATA accredited laboratory of SGS. The purpose of these tests was to assess soil aggressivity. The results are summarised below (Table 2) and detailed in the attached certificates.

Table 2 : Results of Chemical Tests

Borehole No	Sample Depth (m)	pH	Sulfate (mg/kg)	Chloride (mg/kg)
BH1	0.5-0.95	8.8	150	3.0
BH1	1.5-1.95	6.2	300	23
BH2	0.5-0.95	8.4	42	2.0
BH2	1.5-1.85	6.8	180	3.2

Point Load Strength Index

Rock cores obtained from the boreholes were photographed and tested at regular depth intervals for determination of Point Load Strength Index (I_{s50}). The point load strength indices for the rock cores and the assessed rock strengths, in accordance with AS1726 (Standards Australia, 2017), are summarised below.

Table 3 : Results of Point Load Strength Index Test

Borehole No	Depth (m)	Diametral $I_{s(50)}$ (MPa)	Axial $I_{s(50)}$ (MPa)	Assessed Strength	
				Diametral	Axial
BH1	6.71-6.76	0.11	2.42	Low	High
	7.81-7.89	0.59	1.29	Medium	High
	8.62-8.72	0.33	1.01	Medium	High
	9.6-9.7	0.55	1.30	Medium	High
	10.3-10.4	0.82	2.77	Medium	High
	11.0-11.1	0.23	1.72	Low	High
	12.1-12.2	1.73	3.60	High	Extremely High
	13.0-13.07	2.08	7.95	High	Extremely High
	14.2-14.3	0.86	1.77	Medium	High
BH2	5.87-6.93	0.34	0.82	Medium	Medium
	6.24-7.30	0.50	1.05	Medium	High
	7.6-7.75	0.68	0.94	Medium	Medium
	8.73-8.83	0.71	1.64	Medium	High
	9.6-9.7	0.96	2.90	Medium	High
	10.5-10.6	0.38	1.47	Medium	High
	11.9-11.20	0.48	2.69	Medium	High
	12.9-13.0	0.81	2.60	Medium	High
	13.07-13.17	0.67	1.01	Medium	High
	14.4-14.55	0.74	0.61	Medium	Medium

It should be noted that Point Load Strength tests could only be carried out on intact (stronger) portions of rock cores. Therefore, strength assessments presented in Table 3 indicate the upper limits of rock strengths.

DISCUSSION AND RECOMMENDATIONS

Rock Classification for Foundation Design

We expect that the proposed pedestrian bridge will be supported on concrete bored piers founded in medium to high strength shale/siltstone bedrock. It is also expected that the footings for the middle bridge piers will be taken well below the railway line.

For the purpose of footing design, the bedrock at the site is classified (Pells, Mostyn, & Walker, Dec 1998) as below:

Table 4 : Rock Classification for Foundation Design

Assessed Rock Class	Depth Range (m)*	
	BH1	BH2
Class V Shale/Siltstone	2.3 (RL89.24) – 4.5 (87.04)	1.7 (RL90.06) – 4.5 (87.26)
Class IV Shale/Siltstone	4.5 (87.04) – 6.3 (85.24)	4.5 (87.26) – 5.7 (86.06)
Class III Shale/Siltstone or better	6.3 (85.24) –> 14.5 (77.04)	5.7 (86.06) –> 14.64 (77.12)

* Approximate only from existing ground surface

Batter Slopes and Retaining Structures

Cut and fill slopes during and after development works should be battered for stability or retained by engineered retaining structures. The following batter slopes are recommended for stability.

Table 5 : Recommended Batter for Cut and Fill Slopes

Material	Temporary	Permanent
Overburden Soils	1.5H:1.0V	2.5H:1.0V
Class V and IV Shale/Siltstone	1H:1.0V	1.5H:1.0V
Class III Shale/Siltstone or better	Sub-vertical	Sub-vertical

No surcharge load shall be placed within 1.5m from the crest of the slope.

For long term stability of battered slopes, appropriate protection in the form of vegetation (clayey soils) or shotcreting (shale bedrock) shall be provided.

If battered slopes steeper than those recommended in Table 5 are required, then excavation faces would need to be retained by engineered retaining structures (gravity or anchored).

Active earth pressure distribution on non-anchored retaining walls may be assumed to be triangular and estimated using following equation:

$$p_h = \gamma k H$$

Where,

p_h = Horizontal active pressure (kN/m^2)
γ = Total density of materials to be retained (kN/m^3)
k = Coefficient of earth pressure (K_a or K_0)
H = Retained height (m)

If retaining structures are anchored or strutted, the pressure distribution on the retaining structure may be assumed to be trapezoidal and estimated as follows:

- p_h is linearly increasing from zero at ground surface (top of retaining wall) to $0.8k\gamma H$ at depth of 0.25H,
- p_h is constant at $0.8k\gamma H$ from depth of 0.25H to 0.75H,
- p_h is decreasing from $0.8k\gamma H$ at depth of 0.75H to zero the base of excavation.

For design of flexible retaining structures where some lateral movement is acceptable, an active earth pressure coefficient (K_a) is recommended. If it is critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest (K_0) is recommended. Recommended earth pressure coefficients for design of retaining structures are presented in Table 6 below.

Table 6 : Recommended Earth Pressure Parameters

Retained Material	Unit Weight (kN/m^3)	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure (kPa)	At Rest Earth Pressure Coefficient (K_o)
Overburden Soils	19	0.35	Ignore	0.5
Class V and IV Shale/Siltstone	23	0.21	350	0.35
Class III Shale/Siltstone or better	23	-	1500	-

It is reiterated that the excavation faces in shale bedrock should be protected from fretting and erosion by shotcreting, which may be reinforced for long term stability.

The above coefficients are based on the assumptions that the ground level behind the retaining structures is horizontal, and the retained material is effectively drained. Additional earth pressures resulting from surcharge loads (structures, traffic etc.) on retained materials and groundwater pressure should also be allowed for in design of retaining structures.

The design of any retaining structure should also be checked for bearing capacity, overturning, sliding and overall stability of the slope.

Subgrade Preparation and Fill Placement

We understand that some filling will be carried out for construction of the ramps for the proposed pedestrian bridge. The following are recommended for subgrade preparation and fill placement.

- Strip existing topsoil and stockpile for possible future use or dispose of the site.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed natural clayey soils and fill to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular materials or low plasticity clay, compacted as described below. Please note that the fill encountered at the site was generally found to be well compacted.
- Repeat proof rolling of soft spots backfilled with granular materials or low plasticity clay. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill material on the proof rolled surface. The fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness (depending on the size of equipment) and compacted to achieve a Maximum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). The fill may comprise crushed sandstone

or low plasticity clay. Natural soils obtained from excavations within the site may also be used, after removal of unsuitable materials, if any, crushing to sizes finer than 75mm and moisture conditioning.

- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798 (Standards Australia, 2007).

Footings

We expect that the proposed pedestrian bridge will be supported on bored piers founded in medium to high strength shale/siltstone bedrock. The following allowable bearing pressure values are recommended for footing design.

Table 7 : Recommended Allowable Bearing Pressure

Founding Material	Ultimate End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)	Allowable End Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Class V Shale/Siltstone	2000	200	700	70
Class IV Shale/Siltstone	3000	300	1000	100
Class III Shale/Siltstone or better	9000	900	3000	300

The recommended allowable shaft adhesion against uplift load shall be taken as half of the shaft adhesion for compressive load presented in Table 7.

As depths to bedrock with the recommended allowable bearing pressures could vary across the site, the founding depths of footings to be constructed will also vary. Therefore, an experienced Geotechnical Engineer should confirm allowable bearing pressures at founding levels during construction, on the basis of assessment made during footing excavation or pier hole drilling

Total settlements of bored piers designed for the above recommended allowable bearing pressures are estimated to be about 1% of pier diameter. Differential settlements are estimated to be about half the estimated total settlements. In order to reduce differential settlement, footings should be supported on materials with similar strength and compressibility.

Aggressivity Assessment

Based on Australian Standard AS2159 (Standards Australia, 2009), aggressive classifications for subsurface materials are shown below.

Table 8 : Aggressivity Classification

Iron & Steel			
pH	Chloride (ppm)	Resistivity ohm.cm	Low Permeability Soil
>5.0	<5,000	>5,000	Non-aggressive
4.0-5.0	5,000-20,000	2,000 – 5,000	Non-aggressive
3.0-4.0	20,000 – 50,000	1,000 – 2,000	Mild
<3.0	>50,000	<1,000	Moderate

Concrete		
pH	Sulphate (ppm)	Low Permeability Soil
>5.5	<5,000	Non-aggressive
4.5-5.5	5,000-10,000	Mild
4.0-4.5	10,000 – 20,000	Moderate
<4.0	>20,000	Severe

1ppm=1mg/kg

Based on the results shown in Table 2 and above classification, the soils at the site are assessed as non-aggressive to both iron/steel and concrete. Concrete strength and cover for reinforcement of structures in contact with the existing soils at the site shall be based on the above assessment.

Pavement Thickness Design

We understand that as part of the proposed development Station Street and Steven Road will be widened. Based on the subsurface conditions encountered at the site and our previous pavement investigation (Report Ref. : 8866/5-AA-R1, 12 May 2020) a design CBR of 4% can be adopted for pavement thickness design. As per Wollondilly Council design specification, the design traffic loading for Station Street can be taken as $2x10^6$ ESA.

Based on the above design CBR and traffic loading values and as per Austroads Guide (Austroads, 2017), the following pavement is recommended.

Table 9 : Recommended Pavement

Road Name	Asphaltic Concrete (mm)+	Base Course (mm)	Sub-base Course (mm)	Total thickness (mm)
Station Street and Stevens Road Widening	50 – AC14	150	340	540

The above pavement depth is valid if the subgrade and pavement materials are compacted to the following Minimum Dry Density Ratios (AS1289 5.4.1) or as per Council's specifications.

Basecourse	98% Modified
Sub-basecourse	98% Modified
Subgrade	100% Standard

The pavement design assumes provision of adequate surface and sub-surface drainage of the pavement and adjacent areas. It is recommended that a sub-surface drainage system is installed, as directed by Council Engineers.

Remarks

Although the bridge will be moved 2m towards the northern side from the previously identified location, it is our assessment that the recommendations provided in this report are still applicable. It should be noted that no major changes in subsurface conditions are expected within 2m distance.

General

Assessment and recommendations presented in this report are based on site observation and information from two (2) boreholes. Although we believe that the sub-surface profile presented in this report is indicative of the general conditions across the site, it is possible that the sub-surface conditions including depth to groundwater level could differ from those encountered in the boreholes. We recommend that this company is contacted for further advice if subsurface materials and groundwater conditions encountered during the construction stage differ from those presented in this report.

If you have any questions, please do not hesitate to contact the undersigned.

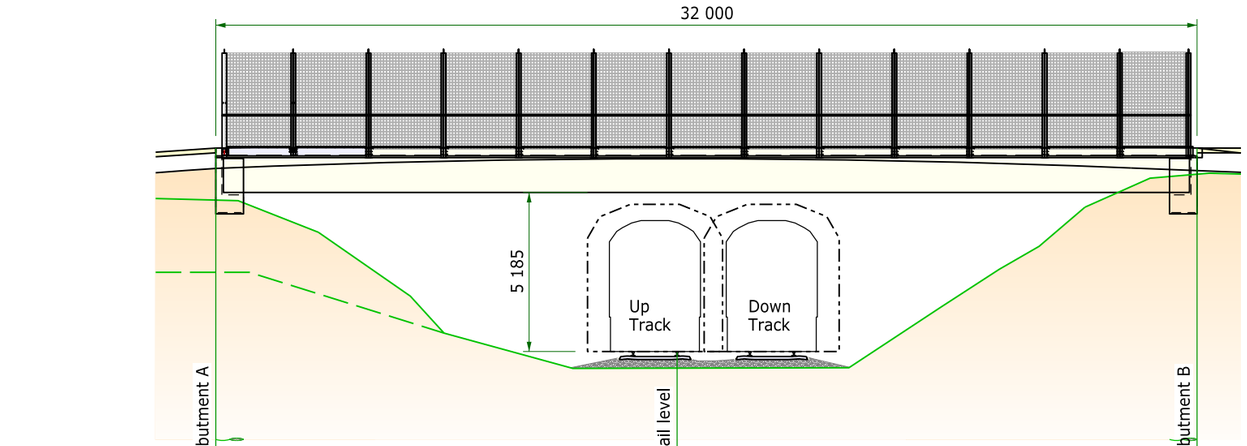
Yours faithfully
GEOTECHNIQUE PTY LTD

ZIAUDDIN AHMED
Senior Associate

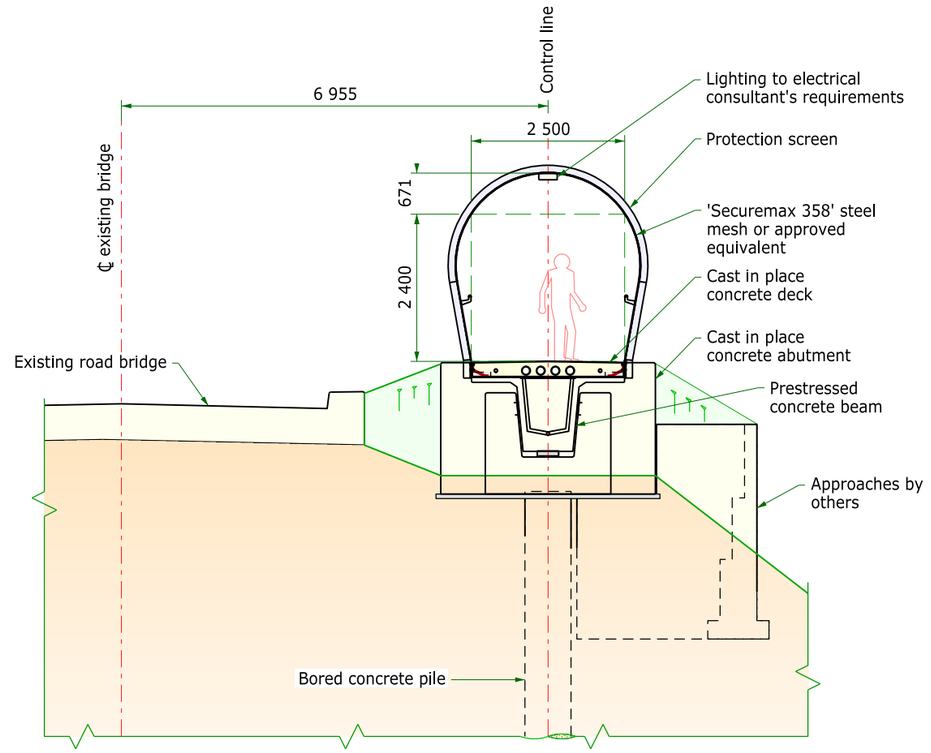
Attached Proposed Bridge Location
Drawing No 14305/10-AA2 Borehole Location Plan
Engineering Borehole Logs, Core Photograph & Explanatory Notes
Chemical Test Results

References

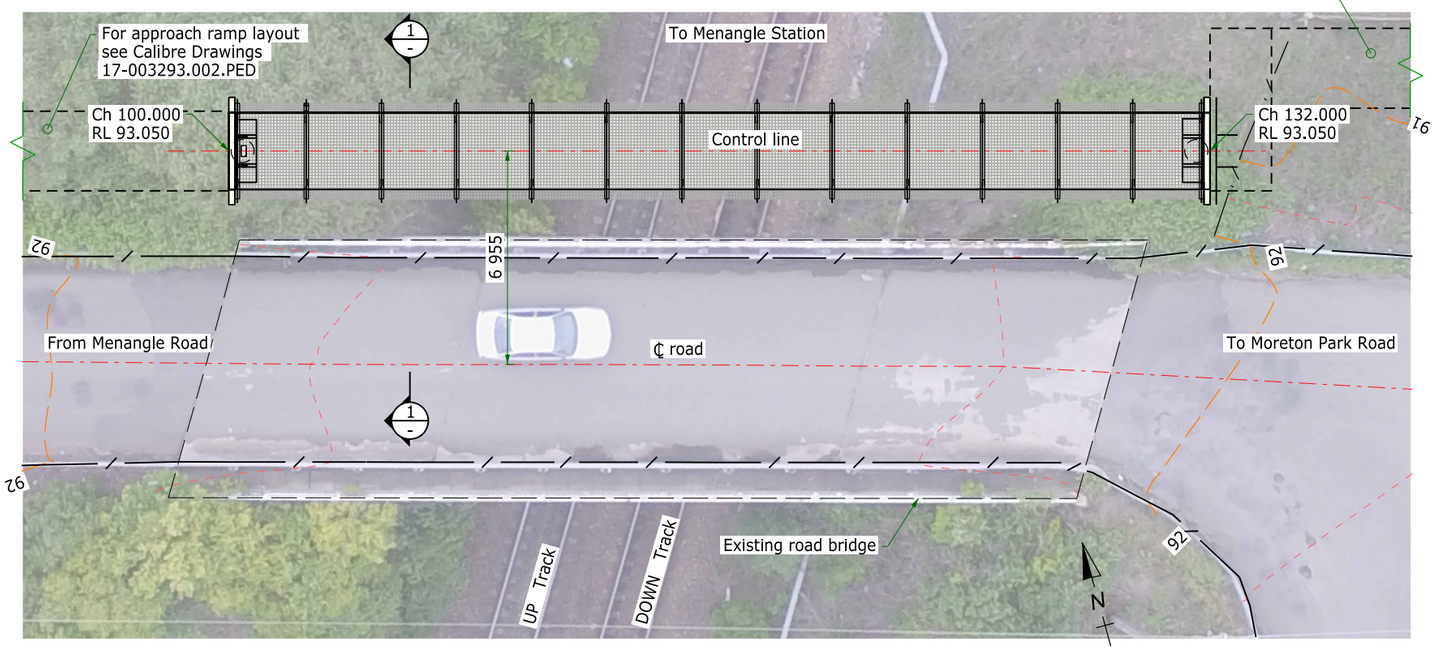
Austroads, 2017. *Guide to pavement technology: part 2: pavement structural design,* Sydney: Austroads.
Pells, P., Mostyn, G. & Walker, B., Dec 1998. Foundations on Sandstone and Shale in the Sydney Region. *Australian Geomechanics,* pp. 17-29.
Standards Australia, 2007. *AS3798-2007 Guidelines on earthworks for commercial and residential developments.* Sydney: SAI Global Limited.
Standards Australia, 2009. *AS2159-2009 Piling - Design and installation.* Sydney: SAI Global Limited.
Standards Australia, 2017. *AS1726-2017 Geotechnical site investigations.* Sydney: SAI Global Limited.



ELEVATION
1:200



SECTION 1
1:100



PLAN
1:200

General Notes

Dimensions in millimetres.
Chainages and levels are in metres.
Reduced levels are to AHD.

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

1:100 0 500 1000 1500 2000 2500 (500 250)
1:200 0 1m 2m 3m 4m 5m (1m 0.5m)
DRAWING SCALES TRUE AT A3

...\Drafting\B1849 D102 GA.dgn 21/07/2022 11:36:21 AM Jim

Bridge Design Pty Ltd
ISO 9001:2008 REGISTERED FIRM
CONSULT AUSTRALIA Member Firm

DESIGN: JRA
VERIFIED: L1
DRAWING: WJS
CHECKED: JRA

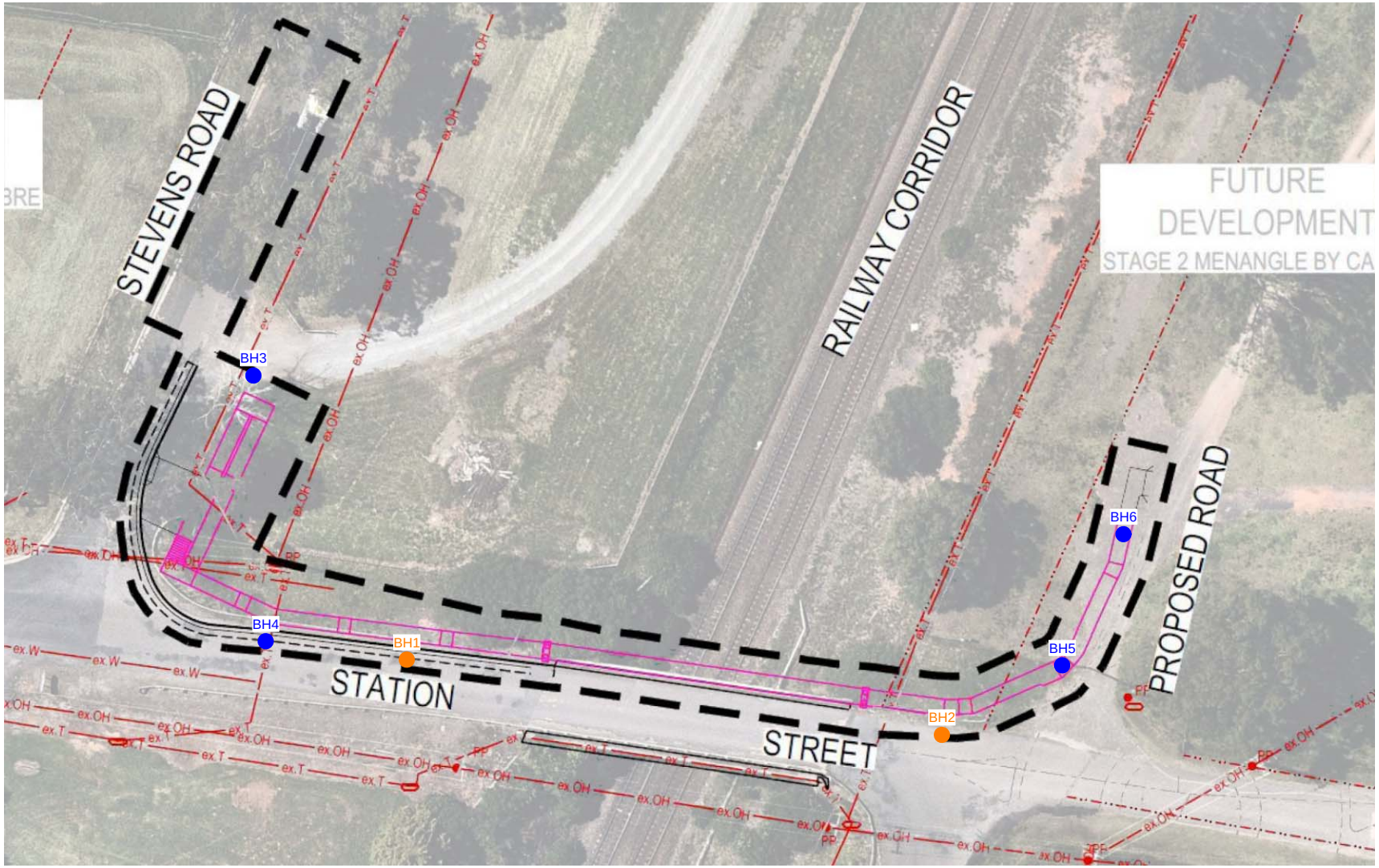
MANAGER, BRIDGE DESIGN PTY LTD

THIS DRAWING IS NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED DIGITALLY ON THIS SHEET OR THE FIRST SHEET IN THIS SET OF DRAWINGS.

Station Street — Wollondilly Shire Council
FOOTBRIDGE OVER RAILWAY LINE
at 0.45km east of Menangle Road
GENERAL ARRANGEMENT

JOB NUMBER B1849
DOCUMENT NUMBER D102
SHEET 2 OF 13
REVISION P1

100mm on original
200mm on original



LEGEND

- Deep Borehole
- Shallow Borehole

0 6 12 18 24 30m

Scale 1:600

GEOTECHNIQUE® PTY LTD

NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

Station Street
Menangle

Borehole Locations

Drawing No: 14305/10-AA2
Job No: 14305/10
Drawn By: MH
Date: 26 May 2021
Checked By: SS/AB/ZA

File No: 14305-10
Layers: 0, AA2

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH1
Date : 10/05/2021
Logged/Checked by: SS/ZA

drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.54

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			AC/Seal (20mm) Roadbase Gravel (200mm)				
		GP							FILL: Silty Clay, low plasticity, grey, with shale gravel				
		GP			N=21 2,10,11	0.5							
		GP				1							
		GP			N=25 11,13,12	1.5							
		G				2		CH	Silty CLAY, high plasticity, red				Red clay in SPT at 1.85m
						2.5			SHALE, grey, extremely to distinctly weathered, low strength				Bedrock No discernable layer of grey clay seen
					N=R 8/70	3							Shale at bottom of SPT
						3.5							
						4							
						4.5			SHALE, grey, distinctly weathered, low to medium strength				

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH1
Date : 10/05/2021
Logged/Checked by: SS/ZA

drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.54

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
	Dry					5 5.5 6							
						6.5 7 7.5 8 8.5 9			Started coring at 6.3m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH1
Date : 10/05/2021
Logged/Checked by : SS/ZA

drill model and mounting : Track Mounted
slope : deg.
R.L. surface : 91.54
core size: NMLC
bearing : deg.
datum : AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Started coring at 6.3m					
				CORE LOSS					
		6.5		SHALE/SILTSTONE	SW-Fr	M-H			6.6m: Is (clay) 6.7m: Is (clay) 6.8m: Jo=20° 6.93m: Is (clay) 6.98m: Is (clay) 7.0m: Is (clay) 7.3m: Jo=45°, pl 7.35m: Cs, Is (clay) 7.46m: Is (clay) 7.6m: Cs, Is (clay) 8.14m: Cs 8.4-8.17m: Cs 8.86m: Jo=cu
		7							
		7.5							
		8							
		8.5							
		9				H			
		9.5							
		10							
		10.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client :	Calibre Professional Services Pty Ltd	**Job No. :**	14305/11
Project :	Proposed Pedestrian Bridge	**Borehole No. :**	BH1
Location :	Station Street, Menangle	**Date :**	10/05/2021
		Logged/Checked by :	SS/ZA

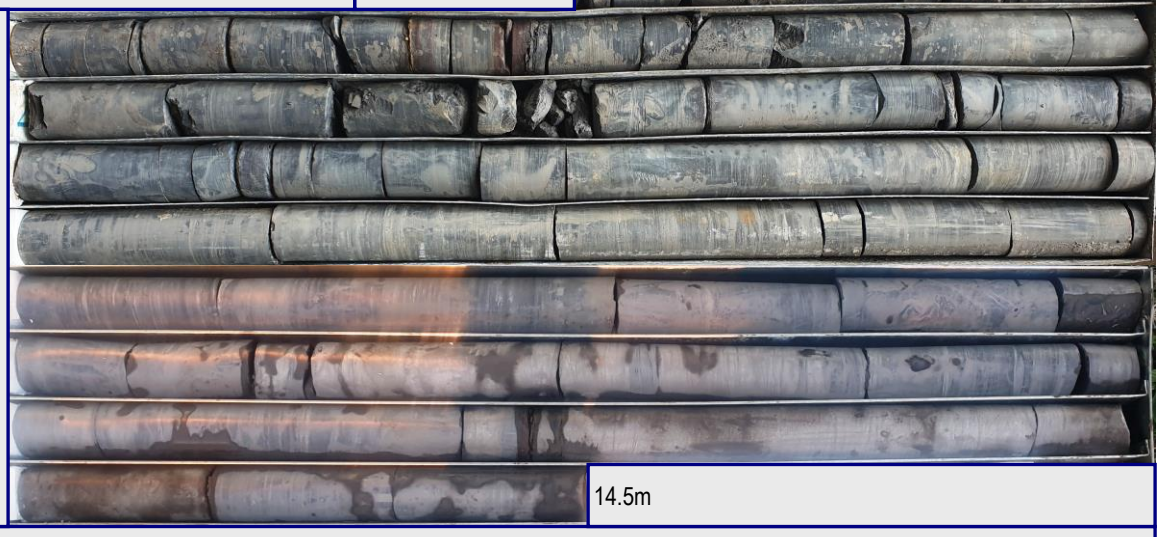
drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.54

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 600 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		11							
		11.5							
		12							
		12.5							
		13							
		13.5							13.46m: Cs, Is (clay) 13.49m: Cs, Is (clay)
		14							
		14.5		Borehole BH1 terminated at 14.5m					
		15							

GEOTECHNIQUE
PTY LTD

Job 14305/11 BH1, Coring Started at 6.3m	Core Loss



14.5m

BH1 terminated at 14.5m

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH2
Date : 11/05/2021
Logged/Checked by: SS/ZA

drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.76

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			AC/Seal (20mm) Roadbase Gravel (200mm)				
		GP							FILL: Silty Clay, low plasticity, grey, with shale gravel				
		GP		DS	N=22 9,10,12	0.5							
		G				1		CH	Silty CLAY, high plasticity, red				No discernable layer of grey clay seen
				DS	N=R 6,16,21/ 50	1.5			SHALE, grey, extremely to distinctly weathered, low strength				Bedrock
						2							
						2.5							
						3							
						3.5							
						4							
						4.5			SHALE, grey, distinctly weathered, low to medium strength				Slight resistance of auger

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH2
Date : 11/05/2021
Logged/Checked by: SS/ZA

drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.76

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
	Dry					5 5.5							
						6 6.5 7 7.5 8 8.5 9			Started coring at 5.7m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH2
Date : 11/05/2021
Logged/Checked by : SS/ZA

drill model and mounting : Track Mounted **slope :** **deg.** **R.L. surface :** 91.76
core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS: defect spacing (mm) 2000 1000 500 300 100 50	DEFECT DETAILS: DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		5.5		Started coring at 5.7m					
				CORE LOSS					
				SHALE/SILTSTONE	SW-Fr	M-H			5.8m: Cs, Is (clay) = 20mm 5.85m: Jo=45°, sealed, Is (clay) 5.86m: Jo=45°, sealed 5.95m: Bp=0°, Is (clay) 5.98m: Bp=0°, Cs, Is (clay) 6.02m: Bp=20°, Is (clay) 6.09m: Cs, Bp=0° 6.2m: Is (clay), Cs 6.23m: Jo=45°
		6							
		6.5							6.46m: Bp=0°, Is (clay)
									6.63m: Bp=0°, Is (clay) 6.67m: Bp=0°, Is (clay)
		7							6.84m: Cs, Is (clay) 6.92m: Cs, Is (clay) = 30mm 7.03m: Cs=20mm 7.13m: Cs, Is (clay)
		7.5							7.43m: Bp=0°, pl, sl, cs 7.45m: Cs 7.5m: Jo=45°, irregular
		8							
		8.5				H			8.6m: Bp=0°, pl
		9							9.02m: Bp=0°
									9.16m: Jo45°, In, Sn (iron)
									9.38m: Bp=0°
		9.5							9.47m: Jo=45°, Ir
									9.75m: Bp=0°
		10							9.95m: Bp=0° 10.03m: Cs

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH2
Date : 11/05/2021
Logged/Checked by : SS/ZA

drill model and mounting : Track Mounted
slope : deg.
R.L. surface : 91.76
core size: NMLC
bearing : deg.
datum : AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS: defect spacing (mm) 2000 1000 500 300 100 50	DEFECT DETAILS: DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		10.5							10.48m: Is (clay)
									10.75m: Bp=0°
		11							
		11.5							
		12							
		12.5							
									12.85m: Jo=45°, Ir
		13							13.05m: Bp=0°
									13.19m: Clay band = 10mm
									13.42m: Jo=45°, pl
		13.5							13.52m: Bp=0°
									13.72m: Cs
									13.73m: Cs, Is (clay)
									13.74m: Jo=90°, Ir
		14							
		14.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Calibre Professional Services Pty Ltd
Project : Proposed Pedestrian Bridge
Location : Station Street, Menangle

Job No. : 14305/11
Borehole No. : BH2
Date : 11/05/2021
Logged/Checked by : SS/ZA

drill model and mounting : Track Mounted
slope : deg.
R.L. surface : 91.76
core size: NMLC
bearing : deg.
datum : AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS: defect spacing (mm) 2000 1000 600 300 100 50	DEFECT DETAILS: DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Borehole BH2 terminated at 14.64m					
		15							
		15.5							
		16							
		16.5							
		17							
		17.5							
		18							
		18.5							
		19							

GEOTECHNIQUE
PTY LTD

Job 14305/11, BH2, Coring Started at 5.7m

14.64m

BH2 terminated at 14.64m

GEOTECHNIQUE PTY LTD

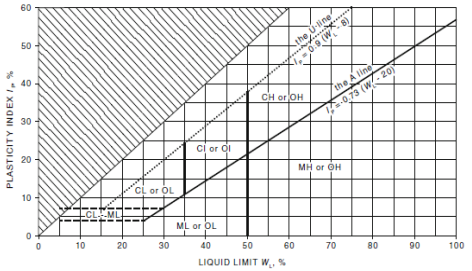
Log Symbols & Abbreviations (Non-cored Borehole Log)

Log Column	Symbol/Value	Description
Drilling Method	V-bit TC-bit RR DB BB	Hardened steel 'V' shaped bit attached to auger Tungsten Carbide bit attached to auger Tricone (Rock Roller) bit Drag bit Blade bit
Groundwater	Dry  	Groundwater not encountered to the drilled or auger refusal depth Groundwater level at depths shown on log Groundwater seepage at depths shown on log
Environment Sample	GP G P	Glass bottle and plastic bag sample over depths shown on log Glass bottle sample over depths shown on log Plastic bag sample over depths shown on log
PID Reading	100	PID reading in ppm
Geotechnical Sample	DS DB U_{50}	Disturbed Small bag sample over depths shown on log Disturbed Bulk sample over depths shown on log Undisturbed 50mm tube sample over depths shown on log
Field Test	N=10 3,5,5 N=R 10,15/100	Standard Penetration Test (SPT) 'N' value. Individual numbers indicate blows per 150mm penetration. 'R' represents refusal to penetration in hard/very dense soils or in cobbles or boulders. The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal
	DCP/PSP: 5 6 R/10	Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. 'R/10' represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.
Classification	GP GW GM GC SP SW SM SC ML MI MH CL CI CH	Poorly Graded GRAVEL Well graded GRAVEL Silty GRAVEL Clayey GRAVEL Poorly graded SAND Well graded SAND Silty SAND Clayey SAND SILT / Sandy SILT / clayey SILT, low plasticity SILT / Sandy SILT / clayey SILT, medium plasticity SILT / Sandy SILT / clayey SILT, high plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity
Moisture Condition Cohesive soils Cohesionless soils	 M<PL M=PL M>PL D M W	 Moisture content less than Plastic Limit Moisture content equal to Plastic Limit Moisture content to be greater than Plastic Limit Dry - Runs freely through hand Moist - Tends to cohere Wet - Tends to cohere
Consistency Cohesive soils	 VS S F St VSt H	**Term** / **Undrained shear strength, C_u (kPa)** / **Hand Penetrometer (Qu)** Very Soft / ≤12 / <25 Soft / >12 & ≤25 / 25 – 50 Firm / >25 & ≤50 / 50 – 100 Stiff / >50 & ≤100 / 100 – 200 Very Stiff / >100 & ≤200 / 200 – 400 Hard / >200 / >400
Density Index Cohesionless soils	 VL L M D VD	**Term** / **Density Index, I_D (%)** / **SPT 'N' (blows/300mm)** Very Loose / ≤15 / ≤5 Loose / >15 & ≤35 / >5 & ≤10 Medium Dense / >35 & ≤65 / >10 & ≤30 Dense / >65 & ≤85 / >30 & ≤50 Very Dense / >85 / >50
Hand Penetrometer	100 200	Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log
Remarks	 Residual Alluvium Colluvial Aeolian Marine	Geological origin of soils Residual soils above bedrock River deposited Alluvial soils Gravity deposited Colluvial soils Wind deposited Aeolian soils Marine Soils

GEOTECHNIQUE PTY LTD

AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification				
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63										
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 0.075	SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**		More than 35% passing 0.075mm	Below 'A' line			
					None to low	Slow to rapid	Low						
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				



GEOTECHNIQUE PTY LTD

Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	Symbol / Abbreviation	Description	
Core Size		Nominal Core Size (mm)	
	NQ	47	
	NMLC	52	
	HQ	63	
Water Loss	◀	Complete water loss	
	◁	Partial water loss	
Weathering (AS1726:2017)	RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported
	XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
	HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	MW	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock
	SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock
	FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'	
Strength (AS1726:2017)		**Term**	**Point Load Strength Index (I_{s50}, MPa)**
	VL	Very Low	≥0.03 ≤0.1
	L	Low	>0.1 ≤0.3
	M	Medium	>0.3 ≤1
	H	High	>1 ≤3
	VH	Very High	>3 ≤10
	EH	Extremely High	>10
Defect Spacing		**Description**	**Spacing (mm)**
		Extremely closely spaced	<20
		Very closely spaced	20 to 60
		Closely spaced	60 to 200
		Medium spaced	200 to 600
		Widely spaced	600 to 2000
		Very widely spaced	2000 to 6000
		Extremely widely spaced	>6000
Defect Description (AS1726:2017) Type			
	Pt	Parting	
	Jo	Joint	
	Sh	Sheared Surface	
	Sz	Sheared Zone	
	Ss	Sheared Seam	
	Cs	Crushed Seam	
	Is	Infilled Seam	
	Ews	Extremely Weathered Seam	
Macro-surface geometry	St	Stepped	
	Cu	Curved	
	Un	Undulating	
	Ir	Irregular	
	Pl	Planar	
Micro-surface geometry	Vro	Very Rough	
	Ro	Rough	
	Sm	Smooth	
	Po	Polished	
	Sl	Slickensided	
Coating or infilling	cn	clean	
	sn	stained	
	vn	veneer	
	cg	coating	

GEOTECHNIQUE PTY LTD

AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)							
More than 20	20	Grain Size Description			At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix	LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix	SALINE ROCKS
	2			Breccia Irregular rock fragments in a finer matrix				Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	Halite Anhydrite
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals		Calcarenite		Cemented volcanic ash TUFF	Gypsum
	0.2		Medium	Quartzite Quartz grains and siliceous cement					
	0.06		Fine	Arkose Many feldspar grains Greywacke Many rock chips					
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone					COAL LIGNITE
				Granular cemented – except amorphous rocks					
				SILICEOUS	CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid					

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)		Rocks with massive structure and crystalline texture (mostly igneous)						Grain size (mm)
Grain size description			Grain size description	Pegmatite			Pyrosenite	More than 20
		MARBLE						20
	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands	QUARTZITE		GRANITE	Diorite	GABBRO	Peridorite	6
COARSE		Granulite	COARSE	These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite				
	Migmatite Irregularly foliated: mixed schists and gneisses	HORNFELS						2
	SCHIST Well developed undulose foliation; generally much mica	Amphibolite		Micorgranite	Microdiorite			0.6
MEDIUM		Serpentine	MEDIUM	These rocks are sometimes phorphyritic and are then described as porphyries		Dolerite		0.2
								0.06
	PHYLLITE Slightly undulose foliation; sometimes 'spotted'			RHYOLITE	ANDESITE			0.002
FINE	SLATE Well developed plane cleavage (foliation)		FINE	These rocks are sometimes phorphyritic and are then described as porphyries		BASALT		Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystalline
CRYSTALLINE				Pale<----------->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Ziauddin Ahmed
Client	Geotechnique
Address	
Telephone	
Facsimile	
Email	
Project	**14305/11 Station Street, Menangle Park**
Order Number	(Not specified)
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	
Telephone	
Facsimile	
Email	
SGS Reference	**SE219533 R0**
Date Received	12/5/2021
Date Reported	19/5/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Shane MCDERMOTT
Inorganic/Metals Chemist

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography [AN245] Tested: 13/5/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 10/5/2021 SE219533.001	BH1 SOIL 1.5-1.95 10/5/2021 SE219533.002	BH2 SOIL 0.5-0.95 11/5/2021 SE219533.003	BH2 SOIL 1.5-1.85 11/5/2021 SE219533.004
Chloride	mg/kg	0.25	3.0	23	2.0	3.2
Sulfate	mg/kg	5	150	300	42	180

pH in soil (1:5) [AN101] Tested: 13/5/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 10/5/2021 SE219533.001	BH1 SOIL 1.5-1.95 10/5/2021 SE219533.002	BH2 SOIL 0.5-0.95 11/5/2021 SE219533.003	BH2 SOIL 1.5-1.85 11/5/2021 SE219533.004
pH	pH Units	0.1	**8.8**	**6.2**	**8.4**	**6.8**

Moisture Content [AN002] Tested: 18/5/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 10/5/2021 SE219533.001	BH1 SOIL 1.5-1.95 10/5/2021 SE219533.002	BH2 SOIL 0.5-0.95 11/5/2021 SE219533.003	BH2 SOIL 1.5-1.85 11/5/2021 SE219533.004
% Moisture	%w/w	1	**4.7**	**15.0**	**8.2**	**16.1**

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

STATEMENT OF QA/QC PERFORMANCE

SE219533 R0

CLIENT DETAILS

Contact	Ziauddin Ahmed
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	ziauddin@geotech.com.au
Project	**14305/11 Station Street, Menangle Park**
Order Number	(Not specified)
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE219533 R0**
Date Received	12 May 2021
Date Reported	19 May 2021

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

HOLDING TIME SUMMARY

SE219533 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the

Moisture Content — Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE219533.001	LB224782	10 May 2021	12 May 2021	24 May 2021	18 May 2021	23 May 2021	19 May 2021
BH1	SE219533.002	LB224782	10 May 2021	12 May 2021	24 May 2021	18 May 2021	23 May 2021	19 May 2021
BH2	SE219533.003	LB224782	11 May 2021	12 May 2021	25 May 2021	18 May 2021	23 May 2021	19 May 2021
BH2	SE219533.004	LB224782	11 May 2021	12 May 2021	25 May 2021	18 May 2021	23 May 2021	19 May 2021

pH in soil (1:5) — Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE219533.001	LB224550	10 May 2021	12 May 2021	17 May 2021	13 May 2021	14 May 2021	13 May 2021
BH1	SE219533.002	LB224550	10 May 2021	12 May 2021	17 May 2021	13 May 2021	14 May 2021	13 May 2021
BH2	SE219533.003	LB224550	11 May 2021	12 May 2021	18 May 2021	13 May 2021	14 May 2021	13 May 2021
BH2	SE219533.004	LB224550	11 May 2021	12 May 2021	18 May 2021	13 May 2021	14 May 2021	13 May 2021

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography — Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE219533.001	LB224549	10 May 2021	12 May 2021	17 May 2021	13 May 2021	10 Jun 2021	19 May 2021
BH1	SE219533.002	LB224549	10 May 2021	12 May 2021	17 May 2021	13 May 2021	10 Jun 2021	19 May 2021
BH2	SE219533.003	LB224549	11 May 2021	12 May 2021	18 May 2021	13 May 2021	10 Jun 2021	19 May 2021
BH2	SE219533.004	LB224549	11 May 2021	12 May 2021	18 May 2021	13 May 2021	10 Jun 2021	19 May 2021

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography — **Method: ME-(AU)-[ENV]AN245**

Sample Number	Parameter	Units	LOR	Result
LB224549.001	Chloride	mg/kg	0.25	<0.25
	Sulfate	mg/kg	5	<5.0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

Moisture Content — **Method: ME-(AU)-[ENV]AN002**

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE219531.006	LB224782.011	% Moisture	%w/w	1	16.7	20.2	35	19
SE219533.003	LB224782.022	% Moisture	%w/w	1	8.2	9.0	42	10
SE219687.001	LB224782.025	% Moisture	%w/w	1	3.1	3.1	62	1

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

pH in soil (1:5) — Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB224550.003	pH	pH Units	0.1	7.4	7.415	98 - 102	100

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography — Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB224549.002	Chloride	mg/kg	0.25	96	100	70 - 130	96
	Sulfate	mg/kg	5	96	100	70 - 130	96

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

SE219533 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

G EOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161
email: info@geotech.com.au

TO: **SGS ENVIRONMENTAL SERVICES**
UNIT 16
33 MADDOX STREET
ALEXANDRIA NSW 2015

PH: **02 8594 0400** **FAX:** **02 8594 0499**
ATTN: **MS EMILY YIN**

Sampling By: SS
Job No: 14305/11
Project: Proposed Pedestrian Bridge
Project Manager:
Location: Station Street, Menangle Park

Sampling details				Sample type		Results required by:								
Location	Depth (m)	Date	Time	Soil	Water									
						pH, sulphate & chloride								KEEP SAMPLE
BH1	0.5 - 0.95	10/05/2021				✓								YES
BH1	1.5 - 1.95	10/05/2021				✓								YES
BH2	0.5 - 0.95	11/05/2021				✓								YES
BH2	1.5 - 1.85	11/05/2021				✓								YES

SGS EHS Sydney COC
SE219533

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Ziauddin Ahmed	Ziauddin Ahmed	12/05/2021			12.5.21

Legend:
WG Water sample, glass bottle
WP Water sample, plastic bottle
USG Undisturbed soil sample (glass jar)
DSG Disturbed soil sample (glass jar)
DSP Disturbed soil sample (small plastic bag)
✓ Test required
* Purge & Trap
# Geotechnique Screen
‡ mole H^{+}/tonne

SAMPLE RECEIPT ADVICE

SE219533

CLIENT DETAILS

Contact	Ziauddin Ahmed
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	ziauddin@geotech.com.au
Project	**14305/11 Station Street, Menangle Park**
Order Number	(Not specified)
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Wed 12/5/2021
Report Due	Wed 19/5/2021
SGS Reference	**SE219533**

SUBMISSION DETAILS

This is to confirm that 4 samples were received on Wednesday 12/5/2021. Results are expected to be ready by COB Wednesday 19/5/2021.
Please quote SGS reference SE219533 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	Client	Sample cooling method	None
Samples received in correct containers	Yes	Sample counts by matrix	4 Soil
Date documentation received	12/5/2021	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	22.0°C	Sufficient sample for analysis	Yes
Turnaround time requested	Standard		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

SE219533

CLIENT DETAILS

Client Geotechnique

Project 14305/11 Station Street, Menangle Park

SUMMARY OF ANALYSIS

No.	Sample ID	Moisture Content	pH in soil (1:5)	Soluble Anions (1:5) in Soil/Solids by Ion
001	BH1 0.5-0.95	1	1	2
002	BH1 1.5-1.95	1	1	2
003	BH2 0.5-0.95	1	1	2
004	BH2 1.5-1.85	1	1	2

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

KEY TO SYMBOLS

Symbol Description

Strata symbols

Paving

Gravel

Fill

Silty clay

Shale

Blank

Description not given for: ">I"

Misc. Symbols

Description not given for: "X"

Notes:

1. **Exploratory borings were drilled on 11/05/2021 using a 4-inch diameter continuous flight power auger.**

2. **No free water was encountered at the time of drilling or when re-checked the following day.**

3. **Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.**

4. **These logs are subject to the limitations, conclusions, and recommendations in this report.**

5. **Results of tests conducted on samples recovered are reported on the logs.**