CALIPH

Preliminary Geotechnical Investigation Report

75 Mary Street, St Peters, NSW

Report No. E22317 GA_Rev3

18 September 2015

Environmental Investigations Australia

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Report Distribution

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75 Mary Street, St Peters, NSW

EI Report No. *E22317 GA_Rev3*

Date: *18 September 2015*

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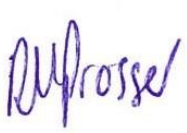	
Rachael Prosser Engineering Geologist	**Alan Morrow** Senior Geotechnical Engineer

Revision	Details	Date	Amended By
A	Draft	20 October 2014	-
0	Final	9 December 2014	MG
1	Basement levels 3&4 deleted	25 March 2015	RP
2	Revision in response to amendment of development drawings	4 September 2015	SK
3	Revision in response to amendment of development drawings	18 September 2015	SK

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1 INTRODUCTION

1.1 BACKGROUND

At the request of Tonkin Zulaikha Greer Architects Pty Ltd (TZG) on behalf of Caliph, Environmental Investigations Australia Pty Ltd (EI) has carried out a Preliminary Geotechnical Investigation (PGI) for the proposed development at 75 Mary Street in St Peters, NSW (the Site).

This PGI report has been prepared to provide preliminary geotechnical advice and recommendations in support of a development application and the preparation of initial concept designs for the proposed residential development. Work has been carried out in accordance with the scope of works outlined in our proposal referenced P12722.2, dated 2 September 2014 and your authorisation to proceed dated 11 September 2014

A Detailed Site Assessment and Preliminary Acid Sulfate Soil Assessment for the Site was also undertaken by EI and is presented separately in the report referenced E22317 AA. The Detailed Site Assessment and Preliminary Acid Sulfate Soil Assessment provide more information on environmental impact on the soils and groundwater at the site from past industrial use. These reports should be read in conjunction with this report.

In 18 September 2015, the PGI report (Ref. E22317 GA_Rev 3) was revised in response to an amendment of the development drawings dated 14 September 2015. Changes to the final site configuration post site development were proposed in the updated development drawings. Relevant geotechnical implications resulted by the amendment are discussed in sections below.

1.2 PROPOSED DEVELOPMENT

Caliph supplied EI with drawings prepared by TZG titled:

- *Proposed Site Plan – Aerial View,* dated 14 September 2015 (Precinct 75, 75 Mary Street);
- *B1 Basement Parking Plan,* dated 14 September 2015 (Precinct 75, 75 Mary Street);
- *B2 Basement Parking Plan,* dated 14 September 2015 (Precinct 75, 75 Mary Street);
- *Ground Floor,* dated 14 September 2015 (Precinct 75, 75 Mary Street);
- *Site Sections,* dated 14 September 2015 (Precinct 75, 75 Mary Street).

At the time of undertaking the ground investigation, based on the drawings provided, EI understood that the proposed development would involve the demolition of the existing buildings at the central and eastern portion of the site, redevelopment of four existing commercial buildings and the construction of three four- to eight-storey buildings over a one to three level stepped basement profile. We anticipated that the basement will extend to a maximum depth of approximately 6 m below existing ground level (mBGL).

1.3 INVESTIGATION OBJECTIVES

The objective of the PGI is to assess site surface and subsurface conditions and to provide preliminary geotechnical advice and recommendations addressing the following:

- Excavation support requirements, including preliminary geotechnical design parameters for retaining walls and shoring systems;
- Excavation methodologies, limitations and monitoring requirements;
- Approaches to limit potential impacts on adjacent structures, services and roads;
- Building and retaining wall foundation options, including;
  - Preliminary design parameters

  - Earthquake loading factor in accordance with AS1170.4:2007;
  - Subgrade preparation and earthworks requirements;
- Construction constraints including groundwater management requirements, if necessary; and
- The requirement for additional geotechnical investigations.

1.4 Scope of Works

The scope of works for the PGI was based on the original set of architectural drawings and included:

- Review of available information from in-house sources;
- Preparation of appropriate health and safety plans;
- Review relevant soil landscape and geological maps for the project area;
- Dial Before You Dig (DBYD) services search and scan of proposed borehole locations for buried conductive services using a licensed service locator;
- Concrete coring through existing concrete hardstand at four borehole locations (BH1 to BH3 & BH6);
- Drilling of six boreholes (BH1 to BH6) by a truck-mounted drill rig using solid flight augers equipped with a 'tungsten-carbide' bit (T-C bit). Boreholes reached T-C bit refusal between 2.81 mBGL and 4.90 mBGL. Approximate borehole locations are shown in **Figure 2**;
- Standard Penetration Testing (SPT) during drilling of the boreholes at between 0.5 m and 1.5 m depth intervals to assess soil strength and collect soil samples for laboratory testing. Soil samples were sent to Macquarie Geotech Pty Ltd (Macquarie), a National Australian Testing Authority (NATA) accredited laboratory;
- Continuation of BH1 to BH6 from T-C bit refusal, using NMLC coring techniques, to termination depths between 6.52 mBGL and 9 mBGL. Rock core recovered from the boreholes was logged, boxed and delivered to Macquarie for testing and storage;
- Measurements of groundwater seepage/levels from boreholes during and immediately post drilling;
- Installation of groundwater monitoring wells in five of the boreholes (BH1/MW1 to BH5/MW5);
- Backfilling the remaining borehole with drilling spoil in the reverse order of excavation and capping of the surface with concrete; and
- Preparation of this PGI report.

The fieldwork was supervised by a Geotechnical Engineer and included logging of subsurface conditions during drilling and locating of boreholes from existing structures.

1.5 Investigation Constraints

The PGI was limited by the preliminary intent of the investigation and the presence of structures and vehicles at the site at the time of the investigation. The discussions and advice presented in this report are intended for the development of initial concept designs for the development. Further geotechnical investigations should be carried out before final design to confirm both the geotechnical and groundwater model, and the preliminary design parameters provided in this report.

2 SITE DESCRIPTION

2.1 SITE DESCRIPTION AND IDENTIFICATION

The site identification details and associated information are presented in **Table 2-1** while the site locality is shown in **Figure 1.**

Table 2-1 Summary of Site Information

Information	Detail
Street Address	75 Mary Street, St Peters, NSW 2044
Lot and Deposited Plan (DP) Identification	Lot 1 in DP 556914, DP 745014, DP 745657, Lot 1 & Lot A DP 87885 and DP 180958.
Local Government Authority	Marrickville Council
Parish	Petersham
County	Cumberland
Current Zoning	IN2 – Light Industrial (Marrickville Local Environment Plan, 2011)
Site Description	The site is irregular in shape. It is bounded to the southwest by Mary Street, to the northwest by residential buildings followed by Unwins Bridge Road, and to the northeast by Edith Street. The site is currently occupied by eleven one- to three-storey brick commercial buildings. All paved surfaces were found to be in good condition.
Site Area	The site is approximately 15,333 m^2 (from Watson Buchan Consulting Surveyors Pty Ltd).

2.2 LOCAL LAND USE

The site is situated within an area of light industrial use. Current uses on surrounding land are described in **Table 2-2**.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
Northeast	Edith Street, with single- to two-storey residential brick buildings beyond.
Northwest	Single-storey residential brick buildings with Unwins Bridge Road beyond
Southeast	Single- to two-storey residential brick and weatherboard buildings.
Southwest	Mary Street, with single- to two-storey brick residential buildings and a two-storey commercial brick warehouse beyond.

2.3 REGIONAL SETTING

The site topography, geological and hydrogeological information for the locality is summarised in **Table 2-3.**

Table 2-3 Topographic, Geological and Hydrogeological Information

Attribute	Description
Topography	The regional topography consists of gently undulating rises with local relief to 30 m. Slopes are usually <5%. Broad rounded crests and ridges with gently inclined slopes. The site is on the side slopes of a minor ridgeline running approximately southwest-northeast along the alignment of the Princes Highway. Local topography slopes gently downwards to the south, at approximately 5 degrees
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1991) indicates the site to be underlain by Ashfield Shale of the Wianamatta Group, which typically comprises black to dark grey shale and laminite. Ashfield Shale generally weathers into silty clay of medium to high plasticity.
Soil Landscapes	The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 (2nd Edition) indicates that the residual landscape at the site likely comprises the Blacktown Landscape. Soils are generally shallow to moderately deep (< 1 m) red and brown podzolic soils on upper slopes; deep (150-300 cm) yellow podzolic soils and soloths on lower slopes. Land is dominantly intensive residential and light and heavy industry. Landscape limitations include moderately reactive, highly plastic subsoil and poor soil drainage.
Acid Sulfate Soils (ASS)	In accordance with the Marrickville Local Environmental Plan 2011 Acid Sulfate Soils Map – Sheet ASS_004, the site falls within a category classified as Class 5 Acid Sulfate Soils (ASS).

An online search was conducted using the NSW Natural Resource Atlas (NRAtlas), which records relevant information pertaining to all licensed water bores for the state of New South Wales revealed six (6) registered, monitoring bores located within 1 km of the site. A review of groundwater bore records for bores within 1 km of the site with standing water levels is summarised in **Table 2-4.**

Table 2-4 Summary of NRA Atlas registered Groundwater Bores

Bore No.	Drilled Date	Bore Depth (mBGL)	SWL (mBGL)	Authorised Bore Purpose
GW109821	1997	35.00	14.50	Monitoring Bore
GW109822	1997	10.45	3.00	Monitoring Bore
GW109823	2000	29.00	12.50	Monitoring Bore
GW109824	2005	20.70	4.51	Monitoring Bore
GW109825	2005	22.00	14.90	Monitoring Bore

3 INVESTIGATION RESULTS

3.1 STRATIGRAPHY

For the development of a site-specific geotechnical model, the observed stratigraphy of shallow fill overlying a residual soil and weathered bedrock profile has been grouped into four geotechnical units. A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 3-1**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in **Appendix A**. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted in the borehole logs are also presented in **Appendix A**.

Table 3-1 Summary of Inferred Subsurface Conditions

Unit	Material	Depth (mBGL) to Top of Unit [1]	Observed Thickness (m)	Material Description [1]	Comments
1	**Fill**	0	0.3 to 0.7	ASPHALT and CONCRETE over mixed FILL	Asphalt and concrete hardstand up to 190 mm thick overlying Sandy CLAY, clayey SILT, CLAY, silty GRAVEL, gravelly CLAY and gravelly SAND with some brick and glass fragments. Fill is inferred to be uncontrolled and poorly compacted.
2	**Residual Soil and Extremely Weathered Shale**	0.3 to 0.7	2.3 to 2.7	Silty CLAY and CLAY	Generally firm to very stiff, medium to high plasticity clay and silty clay with trace fine to medium, sub-rounded ironstone gravel grading to extremely weathered, extremely low strength shale with depth. A softened surficial zone approximately 1.0 m thick was encountered in BH2. SPT N values range from 1 to 17.
3	**Distinctly Weathered Shale**	2.5 to 3.0	4.1 to 4.7	MUDSTONE and SHALE	Generally distinctly weathered, very low to low strength, mudstone and shale. 0-10º bedding. Defects within Unit 3 are generally closely spaced (< 50 mm spacing) sub-horizontal bedding partings, crushed seams and decomposed seams. Some minor joint sets at 30-45º were observed. Unit 3 is classified as Class V to Class IV Shale in accordance with Pells (2004).
4	**Slightly Weathered to Fresh Shale**	6.5 to 7.5	N/A [2]	SHALE	Slightly weathered to fresh, low to medium strength shale. 0-10º bedding, <1-3 mm thick. Defects within Unit 4 are generally moderately spaced (~ 200 mm spacing) sub-horizontal bedding partings with occasional joints inclined to 80º. Unit 5 is classified as Class III Shale in accordance with Pells (2004).

Notes:

1 Approximate depth below ground level at the time of our investigation. More detailed descriptions of subsurface conditions are available in the borehole logs in **Appendix A.** Depths may vary across the site.
2 Unit 4 was observed up to borehole termination depth in BH1, BH2, BH4 BH5 and BH6

3.2 GROUNDWATER

Groundwater seepage inflows were observed during the drilling of BH4, with standing groundwater measurements taken on 25 September 2014 and 8 October 2014. Groundwater measurements taken during drilling and during the monitoring visit are presented in **Table 3-2**.

Table 3-2 Summary of Groundwater Conditions

Borehole ID	Date of Observation	Depth to Groundwater (mBGL)
BH1/MW1	24/09/2014	-
	25/09/2014	3.85
	8/10/2014	3.16
BH2/MW2	23/09/2014	-
	25/09/2014	1.39
	8/10/2014	1.55
BH3/MW3	25/09/2014	-
	8/10/2014	1.00
BH4/MW4	24/09/2014	0.03
	25/09/2014	1.14
	8/10/2014	1.79
BH5/MW5	23/09/2014	-
	25/09/2014	0.89
	8/10/2014	1.07

3.3 LABORATORY TEST RESULTS

Six soil samples and one groundwater sample were selected for laboratory testing to assess the following:

- Soil moisture content and Atterberg Limits (Liquid Limit and Plastic Limit); and
- Soil and groundwater aggressivity (pH, Chloride and Sulfate content and electrical conductivity).

A summary of soil and groundwater test results is provided in **Table 3-3**.

Fifteen rock core samples were tested by Macquarie to determine Point Load Strength Index (Is_{50}) values to assist with rock strength classification. The results of the testing are shown on the borehole logs at the appropriate depths.

Laboratory test certificates are presented in **Appendix B**

Table 3-3 Summary of Laboratory Test Results

Test/ Sample ID		BH1-3 (1.5-1.95 mBGL)	BH2-2 (0.5-0.95 mBGL)	BH2-3 (1.5-1.95 mBGL)	BH3-3 (1.5-1.95 mBGL)	BH4-2 (0.5-0.95 mBGL)	BH5-4 (1.5-1.95 mBGL)	MW3
Unit		Unit 2	Unit 2	Unit 2	Unit 2	Unit 2	Unit 2	-
Material Description [1]		Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Groundwater
Atterberg Limits	Liquid Limit (%)	56	64	-	54	58	59	-
	Plastic Limit (%)	19	23	-	20	20	21	-
	Plasticity Index (%)	37	41	-	34	38	38	-
Moisture Content (%)		17.2	42.9	-	18.3	35.4	19.3	-
Soil Aggressivity	pH	-	-	5.4	-	-	-	4.8
	Resistivity (Ω.cm)	-	-	12000	-	-	-	625
	Sulfate SO_4 (mg/kg)	-	-	424.1	-	-	-	330
	Chloride Cl (mg/kg)	-	-	106.4	-	-	-	260

Notes:

1 More detailed descriptions of the subsurface conditions at borehole locations are available in the borehole logs presented in **Appendix A**.

4 GEOTECHNICAL DISCUSSIONS AND PRELIMINARY DESIGN ADVICE

The main geotechnical factors for the design of the development include:

- Basement excavatability.
- Basement excavation retention to prevent potential lateral deflections and ground loss as a result of excavations.
- Foundation design for building loads.
- The likelihood of the proposed basement excavation intersecting the groundwater table.

Geotechnical discussions and preliminary design advice is presented in **Table 4-1**. The advice and parameters presented in **Table 4-1** are intended for the development of initial concept designs. Further geotechnical investigation should be carried out before final design to confirm the preliminary design parameters provided here.

Table 4-1 Geotechnical Discussions and Preliminary Design Advice

	Preliminary Design [1]	Geotechnical Constraints [2]	Discussions and Preliminary Design Advice [2]	Preliminary Design Parameters [2]					
				Material [3]		Unit 1 Fill	Unit 2 Residual Soil and Extremely Weathered Shale	Unit 3 Distinctly Weathered Shale	Unit 4 Slightly Weathered to Fresh Shale
				Typical Depth to Top of Unit (mBGL) [4]		0	0.3 - 0.7	2.5 - 3.0	6.5 - 7.5
				Bulk Unit Weight (kN/m^3) [5]		17	19	23	23
				Elastic Modulus (MPa)		5	25	50	250
Basement Excavations and Earthworks	• Up to two levels of basement car parking. Excavation for the basement is expected to extend to a maximum depth of approximately 6 m.	• Proposed excavation will likely encounter Units1, 2, and 3.	• Temporary batters may be considered for retention of material encountered during basement excavation where site constraints allow. • Where excavations extend beneath the zone of influence of nearby structures/ services/ pavements basement retention will be required. • Units 1, 2 and 3 should be diggable with a 20t Hydraulic Excavator with some hard ripping. • All earthworks should be carried out in accordance with AS3798: 2007. This standard applies to any site filling undertaken and to the preparation of basement slab subgrades.	Batter Angle [6]	Temporary [6]	2H:1V	1.5H:1V	1H:1V	-
					Permanent [6]	3H:1V	2H:1V	1H:1V	-
Excavation Retention			• Cantilevered retaining walls are typically the most economically viable retention method up to 5 m height. Anchored walls may be more economically viable above 5 m height and may be required to limit lateral deflections where retention systems are within the zone of influence of nearby structures/ services/ pavements. • Consideration will need to be given to the interface of soil retention and rock support in excavations. Further discussion of this is given in **Section 4.1**. • Consideration will need to be given to monitoring lateral and vertical deflections of retained soil and to monitoring construction induced vibrations. Further discussion of this is given in **Section 4.2**. • Parameters given in this table for design of deep foundations may be used for design of basement retention systems.	Earth Pressure Coefficients	At rest, K_o [7]	0.69	0.63	0.3	-
					Passive, K_p [7]	N/A	2.20	4.5	1500 kPa ultimate stress block
					Active, K_a [7]	0.53	0.45	0.15	-
Foundations	• Two to eight-storey buildings over one to two levels of stepped basement parking.	• Final excavation levels likely to be in Unit 3 material.	**Shallow Foundations** • All shallow footings should found below Unit 1 materials to avoid the potential of potentially large settlements caused by founding in these uncontrolled materials. • Shallow footings on Unit 2 – Residual Soil should be designed in accordance with AS2870:2011 based on a Site Classification of 'H2' provided that uncontrolled fill material is stripped before footing construction. • Consideration must be given to the possibility of differential settlement caused by foundations for a structure spanning the interface of differing materials. Further discussion of this is given is **Section 4.3**.	Preliminary Allowable Bearing Pressure (kPa) [8]		N/A	150	700	2000
				Undrained shear strength, c_u (kPa)		-	50	-	-
				Drained friction angle, ϕ' (°)		-	23	-	-
				Drained cohesion, c' (kPa)		-	15	-	-
			Deep Foundations • Deep foundations may be considered where high lateral or axial loads are to be supported. • The parameters given may also be used for design of retention support. • We recommend that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.40 is used for the preliminary design of piled support in accordance with AS 2159:2009 based upon the preliminary nature of the soil parameters given. The GSRF may be increased upon finalising the development details and subject to further assessments having been carried out e.g. pile testing.	Ultimate Vertical End Bearing Pressure (kPa) [9, 11]		N/A	600	2000	6000
				Ultimate Shaft Adhesion (kPa) [10, 11]	in Compression	0	50	75	350
					in Uplift	0	25	37.5	175
				Susceptibility to Liquefaction during an Earthquake [12]		Medium to Low	Low	Low	Low

	Preliminary Design [1]	Geotechnical Constraints [2]	Discussions and Preliminary Design Advice [2]	Preliminary Design Parameters [2]				
				Material [3]	**Unit 1 Fill**	**Unit 2 Residual Soil and Extremely Weathered Shale**	**Unit 3 Distinctly Weathered Shale**	**Unit 4 Slightly Weathered to Fresh Shale**
				Typical Depth to Top of Unit (mBGL) [4]	0	0.3 - 0.7	2.5 - 3.0	6.5 - 7.5
				Bulk Unit Weight (kN/m^3) [5]	17	19	23	23
				Elastic Modulus (MPa)	5	25	50	250
Groundwater Management	• Excavation for the basement is expected to extend up to a maximum depth of approximately 6 mBGL.	• Groundwater levels measured after the investigation indicate groundwater at approximately 1 to 2 mBGL.	• Groundwater is expected to be encountered within the basement excavations. Groundwater flows may be moderate from fractured zones within the rock mass. Groundwater management options may include the grouting of water bearing fractures during excavation or the installation of drainage systems behind the excavation retention facing. • Further investigation is recommended to determine the extent of seasonal variation on the groundwater table. • Development of a Dewatering Management Plan will be required. • Surface water seepage into these excavations may occur during and following periods of rainfall. Surface water should be controlled by diverting overland flows away from excavations and may be managed by conventional sump and pump methods.					
Soil and Groundwater Aggressivity	• Proposed structure will incorporate buried concrete and steel elements. • AS2159:2009 gives guidelines for foundation susceptibility to soil and groundwater aggressivity.	• Low permeability soils above and below the groundwater table.	• Analysis of the pH, chloride and sulfate content and electrical conductivity of the soil and groundwater was compared with criteria in AS 2159:2009, providing the following exposure classifications: o 'Mildly aggressive' for buried concrete structural elements; and o 'Moderately aggressive' for buried steel structural elements.					
Earthquake Site Risk Classification			• AS1170.4:2007 indicates an earthquake subsoil class of Class B_e – Rock Site for the site. • AS 1170.4:2007 indicates that the hazard factor (z) for Sydney is 0.08.					

Notes:

1 Design details are based on proposed development details provided by TZG at the time of the preparation of this report.

2 Advice and parameters presented in this PGI report are intended for DA purposes and for the development of initial concept designs for the development. Further geotechnical investigation should be carried out before final design to confirm both the geotechnical model and the preliminary design parameters provided in this report.

3 More detailed descriptions of subsurface conditions are available in the borehole logs in **Appendix A.** Depths may vary across the site.

4 Approximate depth below ground level at the time of our investigation. More detailed descriptions of subsurface conditions are available in the borehole logs in **Appendix A.** Depths may vary across the site.

5 Unit Weight is based on visual estimate only, order of accuracy is about 10%.

6 Batter angles recommended are based upon ground conditions encountered in the borehole locations only. Ground conditions may vary and preliminary batter angles should be confirmed by additional geotechnical investigations and inspections during construction by an experienced geotechnical engineer. Batter angles provided assume an overall batter height of less than 5 m. Should batters extend beyond 5 m, batter designs should be carried out by an experienced geotechnical engineer and may need to incorporate benches. Batters given for rock units may only be used with consideration of rock support systems such as pattern bolting, spot bolting or shotcreting based upon the rock mass characteristics encountered during excavation. Inspection during construction by an experienced geotechnical engineer or engineering geologist will be required to determine temporary and permanent rock support requirements. Permanent batters may require surface protection to prevent erosion and slaking.

7 Earth pressures are provided on the assumption that the ground behind the retaining wall is flat and drained.

8 Bearing pressures given are indicative only and will vary according to footing type, shape and embedment and should be confirmed by additional geotechnical investigations, design checks and foundation inspections during construction by an experienced geotechnical engineer.
To adopt these bearing pressures we have assumed that:
- Shallow footings have an embedment depth of at least 750mm into the founding material.
- The bases of all footings are cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to footing construction to verify that ground conditions meet design assumptions.

9 Ultimate geotechnical strengths are provided for use in limit state design. Allowable or serviceability bearing pressures and side adhesions may be estimated using factors of safety of 3 and 2, respectively. These are the factors of safety generally adopted in geotechnical practice to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing width. Assumes the base of pile holes are clean and penetrate at least 1.0m or 2 pile diameters, whichever is greater, into the respective Unit.
Bearing pressures may vary and must be confirmed by additional geotechnical investigations and foundation inspections during construction by an experienced geotechnical engineer.
Higher bearing pressures may be applied upon confirmation by additional geotechnical investigations and subject to an experienced geotechnical engineer carrying out foundation inspections during construction.

10 Side adhesion values given assume there is intimate contact between the pile and foundation material. Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678-2002 Earth Retaining Structures.

11 To adopt these parameters we have assumed that:
- Piles have an embedment depth of at least two pile diameters or 1 m, whichever is greater, into the relevant founding material;
- There is intimate contact between the pile and foundation material;
- Potential soil and groundwater aggressivity will be considered in the design of bored piles;
- The bases of all pile excavations are cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used; and
- An experienced Geotechnical Engineer has reviewed the pile designs to assess whether all recommendations presented in this report have been incorporated in the design.

12 Susceptibility to liquefaction during an earthquake is based on the following definition:
Low - Medium to very dense sands, stiff to hard clays, and rock
Medium - Loose to medium dense sands, soft to firm clays, or uncontrolled fill below the water table
High - Very loose sands or very soft clays below the water table

4.1 EXCAVATION RETENTION

Rigid retaining structures, such as propped or anchored walls, should be adopted to limit lateral and vertical movements when in close proximity to existing buildings, buried services and pavement. We recommend the use of closely spaced soldier pile walls or contiguous reinforced concrete bored pile walls that are socketed into Class III Shale or better.

If cantilevered piles are employed for the design, relatively flexible shoring systems may be used, adopting a triangular earth pressure distribution using active pressures presented in **Table 4-1**. For design of rigid walls, a trapezoidal earth pressure distribution should be used with a maximum pressure of $0.65*K_a*\gamma*H$ (kPa) where 'H' is the effective vertical height of the wall in metres. For excavations spanning the interface of soil and rock, 'H' may be taken as the depth to a zero active earth pressure coefficient.

In addition, design of retaining walls should consider the following:

- If piled retaining walls are to provide permanent support to proposed structures, pile sockets in rock may need to be longer to accommodate additional lateral and axial loads. Anchoring may be required for additional lateral support.
- Care must be taken to ensure that the bored piles found in rock below neighbouring foundation and basement levels, where present.
- The effect of stress relief in the rock on neighbouring foundation systems and pavements, resulting from proposed excavations, should be considered in the retaining wall design.
- Static water pressures should be taken into consideration, unless subsoil drainage is provided behind retaining walls. A hydrostatic pressure distribution could be used for this analysis.

Appropriate surcharge loading from construction equipment and vehicular traffic at finished surface level should be adopted. Any applicable surcharge loads should be taken into account in the retention design.

We recommend that a geotechnical engineer inspect battered and unsupported excavations and excavation support installations to confirm inferred geotechnical conditions. This will allow for the assessment of design assumptions and to provide further advice with regards to excavation retention / support and proposed construction methodologies, if required.

4.2 BASEMENT EXCAVATION MONITORING

Consideration should be made to the impact of the proposed development upon neighbouring structures. Basement excavation retention systems should be designed so as to limit lateral deflections to allowable levels.

Contractors should also consider the following limits associated with carrying out excavation and construction activities:

- Limit lateral deflection of temporary or permanent retaining structures;
- Limit vertical settlements of ground surface at common property boundaries and services easement; and
- Limit peak particle velocities (ppv) from vibrations, caused by construction equipment or excavation, experienced by any structure within bounding properties and the services easement.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations/ services/ pavements and other structures located within or near the zone of influence of the excavation. Measurements should be taken:

- Prior to commencement of excavations;
- Immediately after installation of any temporary or permanent retaining structures;
- Immediately after the excavation has reached a depth of 1.5 m, and each 1.5 m depth increment thereafter;
- Immediately after the excavation has reached bulk excavation level; and
- Immediately after backfilling behind retaining structures.

Vibration monitoring should be carried out periodically during excavation works, particularly at the base of external walls of existing buildings in closest proximity to the excavation and easement. EI recommends an upper limit for ppv of 3 mm/sec is adopted for sensitive structures such as the Telstra, Ausgrid and Sydney Water mains (or as recommended by utility owner), 10 mm/sec is adopted for residential buildings and 20 mm/sec is adopted for commercial and industrial buildings or reinforced concrete structures.

An ongoing monitoring programme will not be required if the contractor can verify, based on trials carried out at the commencement of the works and with the agreement of a Geotechnical Engineer, that the ppv will not exceed set limits. However, should equipment used during excavation and construction works vary from that used during the trial or as agreed, further vibrations assessments by a Geotechnical Engineer, and/ or an ongoing monitoring programme, may be required. Alternatively, saw cutting the perimeter of the excavation in medium or higher strength, if encountered, may limit the impact of vibrations resulting from rock hammering on adjacent structures.

Should vibrations, settlements or deflections exceed set limits, we recommend the following:

- Cease excavation works and notify the Geotechnical Engineer immediately;
- Backfill excavations or support exposed excavations with buttresses or props, where settlement/ lateral movement limits have been exceeded; and
- Develop an alternative excavation/ support plan in conjunction with the Structural and Geotechnical Engineers.

4.3 FOUNDATIONS

Should the proposed development be supported by shallow pad or strip footings or a stiffened raft slab on Unit 2 or 3 material variable ground conditions may cause difficulties for subgrade preparation. Selection of footing types and founding depth will need to consider the risk of adverse differential ground movements within the foundation footprint and between high level and deeper footings. Unless an allowance for such movement is included in the design of the proposed development, we recommend that all new structures found on natural materials with comparable end bearing capacities. Possible features designed to accommodate potential differential movement of the structures may include movement joints, dowelled connections or shear keys.

4.4 CONSTRUCTION CONSIDERATIONS FOR THE ASHFIELD SHALE FORMATION

Long and intermediate term durability of exposed residual soil and rock is a major concern within the Ashfield Shale formation. Exposure of residual soil and weathered rock due to excavation can lead to rapid degradation of the material. Slaking of rock faces, erosion of soil cuts and softening of foundation subgrade material may occur quickly after excavation. Formations will need to be protected with blinding concrete without undue delay to limit any degradation of these materials.

5 CONCLUSIONS

Based on the findings of this report and within the limitations of geotechnical investigations, EI considers the following geotechnical factors will influence the possible development of the site, including:

- Basement excavatability.
- Basement excavation retention to prevent potential lateral deflections and ground loss as a result of excavations.
- Foundation design for building loads.
- The likelihood of the proposed basement excavation intersecting the groundwater table.

In summary, and considering the limitations of geotechnical investigations, EI considers there is a low risk of geotechnical conditions preventing the proposed development if the recommendations of this report are considered for the preliminary design and construction of the development.

6 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

The adopted investigation scope was limited by the investigation intent and by the presence of structures at the site during the investigation. As detailed in Section 1, revised drawings indicating options to take the basement to two levels were received after the ground investigation and issue of the draft report. As such the target depth of the boreholes was based on the original set of drawings that indicated a single–level basement. If a two level basement (or more) option is chosen, further geotechnical investigations, consisting of a minimum of three boreholes, should be carried out to confirm the results and address any limitations prior to adoption of the recommendations of this report for detailed design. These investigations should be carried out once preliminary design and construction details are available and should include:

Excavations

- Dilapidation surveys should be carried out on existing structures that may be impacted by any proposed excavations, particularly where located within the zone of influence of excavations. These surveys should be carried out by a qualified structural engineer and/or geotechnical engineer prior to and following completion of construction works.
- All excavated material transported off site should be classified by EI in accordance with NSW EPA (2014) Waste Classification Guideline, Part 1: Classifying Waste.

Foundations

- Further testing should be carried out as part of the recommended additional ground investigation prior to final design to confirm the design parameters given in this report for the formulation of concept designs.
- If higher allowable bearing pressures are required for the design of deep foundations, additional deep cored boreholes to confirm the quality of Unit 4 Shale should be conducted. Boreholes should be taken a minimum of 3m below the proposed basement excavation level.

Construction

- Working platforms for construction plant, placed on in-situ materials or on engineered fill, should be designed by an experienced and qualified geotechnical engineer.
- A suitably qualified geotechnical engineer from EI is to assess the condition of exposed material at foundation or subgrade level to assess the ability of the prepared surface to act as a foundation or as a subgrade.
- On-going monitoring of ground vibrations, settlements and lateral movements in conjunction with survey results should be carried out during basement excavation.
- Regular inspections by an engineer from EI of battered and unsupported excavations where localised excavations are proposed, to confirm inferred geotechnical conditions, to assess the suitability of design assumptions and to provide further advice with regards to excavation retention/ support and proposed construction methodologies, if required.

7 STATEMENT OF LIMITATIONS

The adopted investigation scope was limited by site access restrictions due to site conditions at the time of our investigation and by the investigation intent. The advice and parameters presented in this PGI report are intended for the development of initial concept designs for the development. Further geotechnical investigation should be carried out before final design to confirm both the geotechnical model and the preliminary design parameters provided in this report.

We draw your attention to the document "Important Information", which is included in **Appendix C** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by EI, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Should you have any queries regarding this report, please do not hesitate to contact EI.

8 References

AS1170.4:2007, *Structural Design Actions, Part 4: Earthquake Actions in Australia*, Standards Australia.

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

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Chapman, G.A. and Murphy, C.L. (1989), Soil Landscapes of the Sydney 1:100000 sheet. Soil Conservation Services of NSW, Sydney.

DMR (1983) Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

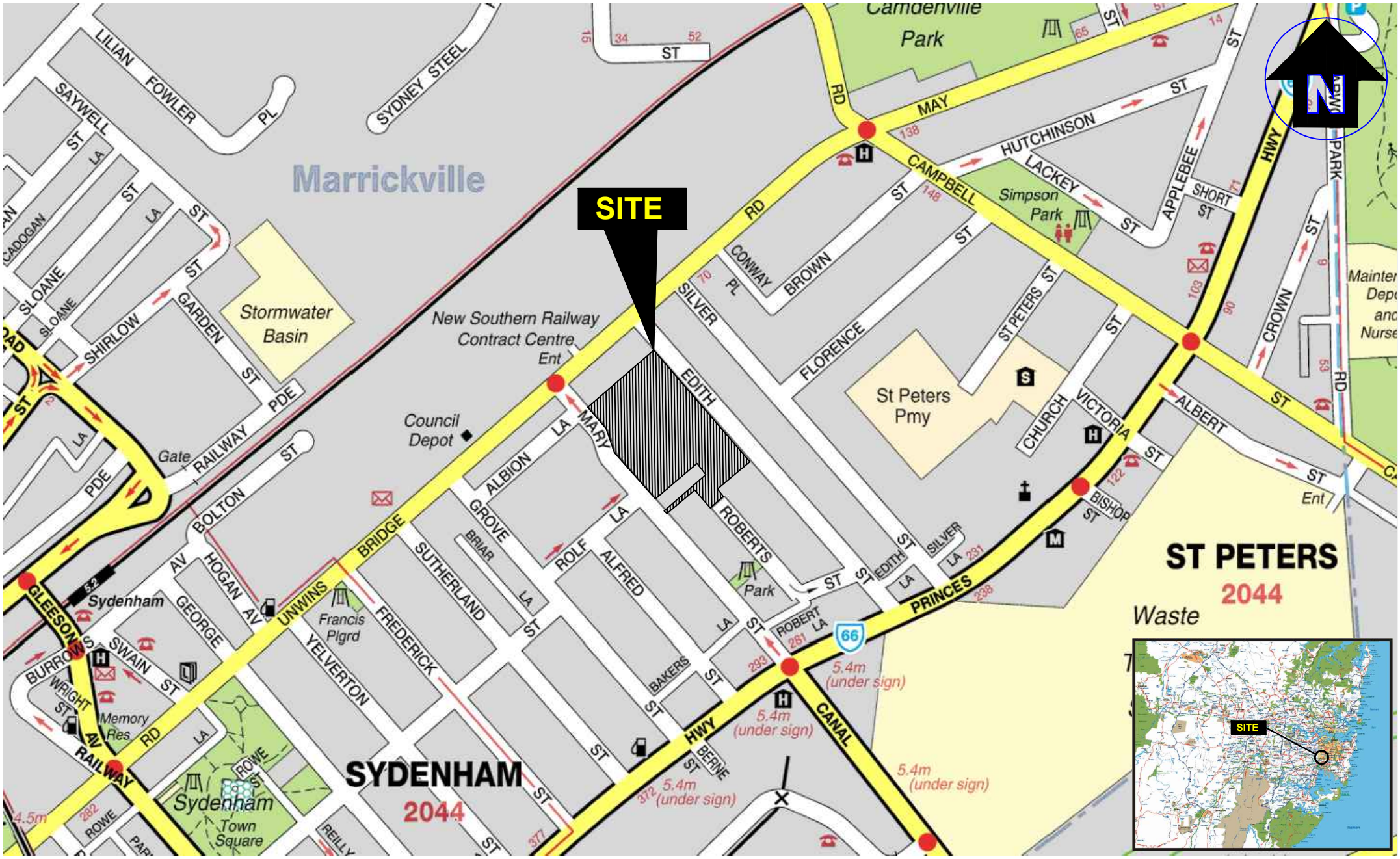
Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

Pettifer and Fookes 1994, A Revision of the Graphical Method for Assessing the Excavatability of Rock, Quarterly Journal of Engineering Geology and Hydrogeology.

9 ABBREVIATIONS

AHD	Australian Height Datum
BGL	Below Ground Level
BH	Borehole
DP	Deposited Plan
EI	Environmental Investigations
ESA	Environmental Site Assessment
NATA	National Association of Testing Authorities, Australia
PGI	Preliminary Geotechnical Investigation

FIGURES



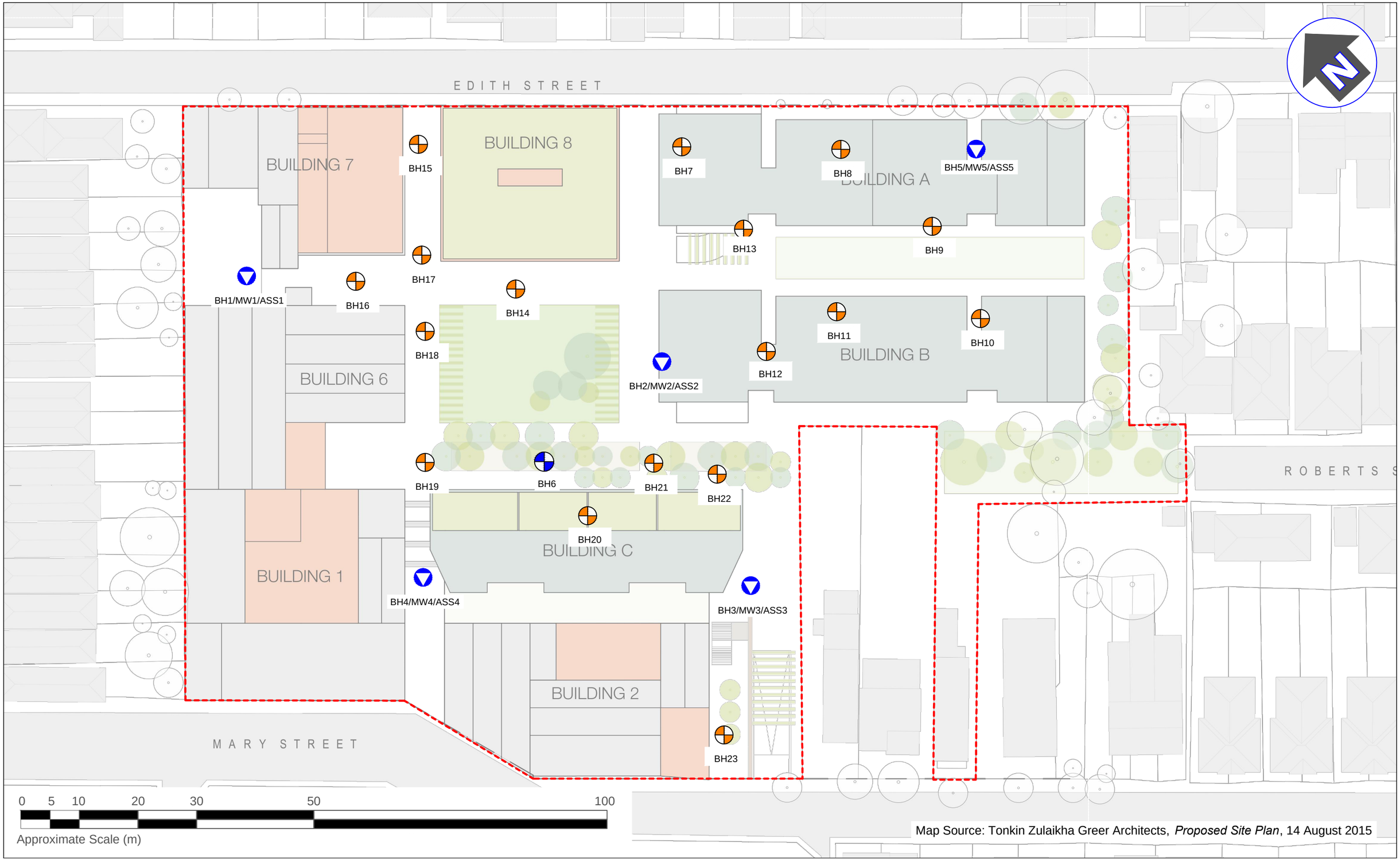
Environmental Investigations Australia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	SK
Approved:	RP
Date:	19/3/15
Approx Scale:	N.T.S

Caliph
Preliminary Geotechnical Investigation
75 Mary Street, St Peters, NSW
Site Locality Plan

Figure:
1

Project: E22317 GA_Rev2



Map Source: Tonkin Zulaikha Greer Architects, *Proposed Site Plan*, 14 August 2015

LEGEND

- Approx. Geotechnical Borehole Locations (EI, 2014)
- Approx. Environmental Borehole Locations (EI, 2014)
- Approx. Site Boundary
- Approx. Monitoring Well/Borehole Locations (EI, 2014)

Environmental Investigations Australia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	SK
Approved:	RP
Date:	19/3/15
Approx Scale:	1:600

Caliph
Preliminary Geotechnical Investigation
75 Mary Street, St Peters, NSW
Borehole Location Plan

Figure: 2

Project: E22317 GA_Rev2

APPENDIX A

BOREHOLE LOG REPORTS AND EXPLANATORY NOTES

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

BOREHOLE: BH1/MW1/ASS1

Project	New Mixed Development			Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	East	331111.5 m	Date Started	24/9/14
Position	Refer to Figure 2	North	6246011.1 m	Date Completed	24/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 24/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.14				-	FILL: CONCRETE; 140 mm.	-	-	CONCRETE HARDSTAND
AD/T	E	GWNE	1	0.30	BH1-1 ES 0.14-0.30 m PID = 4.2 ppm ASS1-1 ES 0.30-0.50 m SPT 0.50 m 1,3,4 N=7 BH1-2 PID = 176 ppm			-	FILL: Sandy CLAY; low plasticity, grey-brown, sand is fine to medium grained, with brick fragments, no odour.	D		FILL
								CH	CLAY; high plasticity, brown with red mottling, trace fine to medium, subrounded ironstone gravel, strong hydrocarbon odour.	M (<PL)	F - St	RESIDUAL SOIL
				1.30	ASS1-2 ES 1.30-1.50 m SPT 1.50 m 5,7,10 N=17 BH1-3 PID = 8.1 ppm				From 1.3 m, as above, grey with orange-red mottling, no odour.		VSt	
	F		2	2.00				-	SHALE; brown-red, inferred extremely low strength, inferred extremely weathered.			WEATHERED ROCK
	H			2.40					From 2.4 m, as above , inferred very low strength, inferred distinctly weathered.	-	-	ROCK
				2.81	SPT 2.80 m 3 HB N=3/10mm BH1-4				Continued as Cored Borehole			
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

Environmental Investigations Australia
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BOREHOLE: BH1/MW1/ASS1

Project	New Mixed Development			Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	East	331111.5 m	Date Started	24/9/14
Position	Refer to Figure 2	North	6246011.1 m	Date Completed	24/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 9/10/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
					2.81		Continuation from non-cored borehole				
NMLC	25/09/14	100	10 (35)	3			SHALE; bedding dipping 0-5 degrees, pale grey with medium to high strength ironstone bands up to 60 mm thick	DW		2.81-3.00: HB 3.00-3.38: BPx8 0 - 5° PR RF Fe SN avg sp = 5-100 mm 3.03-3.06: CS 30 mm, gravel, fine-coarse, angular 3.07-3.08: CS 10 mm, gravel, fine-coarse, angular 3.10-3.11: DB 3.15-3.16: CS 10 mm, gravel, fine-medium, angular 3.24-3.25: CS 10 mm, gravel, fine-medium, angular 3.27: JT 0 - 10° UN S Fe SN 3.40-3.43: JT 0 - 60° CU RF Fe SN 3.44-3.95: BPx10 0 - 10° PR RF Fe SN avg sp = 10-100 mm 3.60-3.61: JT 30° ST RF Fe SN 3.66-3.68: JT 0 - 40° ST RF Fe SN 3.71-3.73: DS 20 mm, silt, low plasticity, firm. 3.83-3.85: DS 20 mm, silt, low plasticity, firm. 4.09-4.10: CS 10 mm, gravel, fine-medium, angular 4.18-5.02: BPx10 0 - 10° PR RF Fe SN avg sp = 10-60 mm 4.22-4.24: JT 45 - 90° CU RF Fe SN 4.28-4.32: CS 40 mm, gravel, medium-coarse, angular 4.38-4.42: JT 45 - 90° CU RF Fe SN 4.47-4.49: CS 20 mm, gravel, fine-medium, angular 4.52-4.59: JT 70° PR RF Fe SN 4.74-4.78: JT 40° PR RF Fe SN 4.83-4.84: CS 10 mm, gravel, fine-medium, angular 4.85-4.88: JT 70° PR RF Fe SN 4.93-4.94: CS 10 mm, gravel, fine-medium, angular 5.08-5.11: CS 30 mm, gravel, fine-medium, angular 5.13-5.17: JT 60° PR closed 5.17: BP 5° PR RF Fe SN 5.20: JT 20° PR RF Fe SN 5.23-5.26: CS 30 mm, gravel, medium-coarse, angular 5.26-5.27: DS 10 mm, silt, low plasticity, firm. 5.28-5.37: JT 70 - 80° PR RF Fe SN 5.30: JT 10 - 40° CU RF Fe SN 5.38-5.46: CS 80 mm, gravel, fine-medium, angular 5.47: BP 0° PR RF Fe SN 5.54-5.56: JT 80 - 90° UN RF Fe SN 5.57: BP 10° PR RF Fe SN 5.60-5.67: CS 70 mm, gravel, fine-medium, angular 5.77-5.78: CS 10 mm, gravel, fine-medium, angular 5.85-6.19: DZ 240 mm, gravelly clay, low plasticity, firm, gravel is medium-coarse, subangular 6.19-6.25: DB 6.26: DB 6.39-6.45: CS 60 mm, gravel, medium-coarse, angular 6.62: BP 0° PR RF Fe SN	
	85-90% RETURN			4	*3.38*		SHALE; bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-2 mm, grey-dark grey with orange iron staining.				
		100	4 (24)	5							
				6							
					6.46			SW			
		100	87 (87)	7			SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = <1-10 mm, dark grey-grey.	FR			
					7.00						
							Hole Terminated at 7.00 m Target depth reached. Borehole converted to monitoring well.				
				8							
				9							
				10							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH1/MW1/ASS1

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

Project	New Mixed Development	East	331111.5 m	Sheet	1 OF 1
Location	75 Mary Street, St Peters NSW	North	6246011.1 m	Date Started	24/9/14
Position	Refer to Figure 2	Contractor	Traccess Pty Ltd	Date Completed	24/9/14
Job No.	E22317	Drill Rig	Multi-Drill 3000	Logged SK	Date: 24/9/14
Client	Caliph	Inclination	-90°	Checked AM	Date: 9/10/14

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID / Static Water Level
DT	-		0	0.14				-	FILL: CONCRETE; 140 mm.	-	-	MW1: Gatic Cover; Concrete
AD/T	E	GWNE	1	0.30	BH1-1 ES 0.14-0.30 m PID = 4.2 ppm ASS1-1 ES 0.30-0.50 m SPT 0.50 m 1,3,4 N=7 BH1-2 PID = 176 ppm			-	FILL: Sandy CLAY; low plasticity, grey-brown, sand is fine to medium grained, with brick fragments, no odour.	D		
								CH	CLAY; high plasticity, brown with red mottling, trace fine to medium, subrounded ironstone gravel, strong hydrocarbon odour.		F - St	
				1.30						M (<PL)		
					ASS1-2 ES 1.30-1.50 m SPT 1.50 m 5,7,10 N=17 BH1-3 PID = 8.1 ppm				From 1.3 m, as above, grey with orange-red mottling, no odour.		VSt	MW1: Sand
	F		2	2.00				-	SHALE; brown-red, inferred extremely low strength, inferred extremely weathered.			MW1: 2x uPVC 50 mm casing
				2.40					From 2.4 m, as above , inferred very low strength, inferred distinctly weathered.	-	-	
	H			2.81								
NMLC	-	25/09/14 85-90% RETURN	3		SPT 2.80 m 3 HB N=3/10mm BH1-4 C 2.81-4.05 m			-	SHALE; bedding dipping 0-5 degrees, pale grey with orange iron staining.			
				3.38								MW1: Bentonite
					3.46 m			-	SHALE; bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-2 mm, grey-dark grey with orange iron staining.			
			4		C 4.05-6.25 m							
			5							-	-	MW1: Sand
			6									MW1: 1x uPVC 50 mm slotted screen
					C 6.25-7.00 m							
				6.46				-	SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = <1-10 mm, dark grey-grey.			
					6.65 m							
			7	7.00					Hole Terminated at 7.00 m Target depth reached. Borehole converted to monitoring well.			
			8									
			9									
			10									

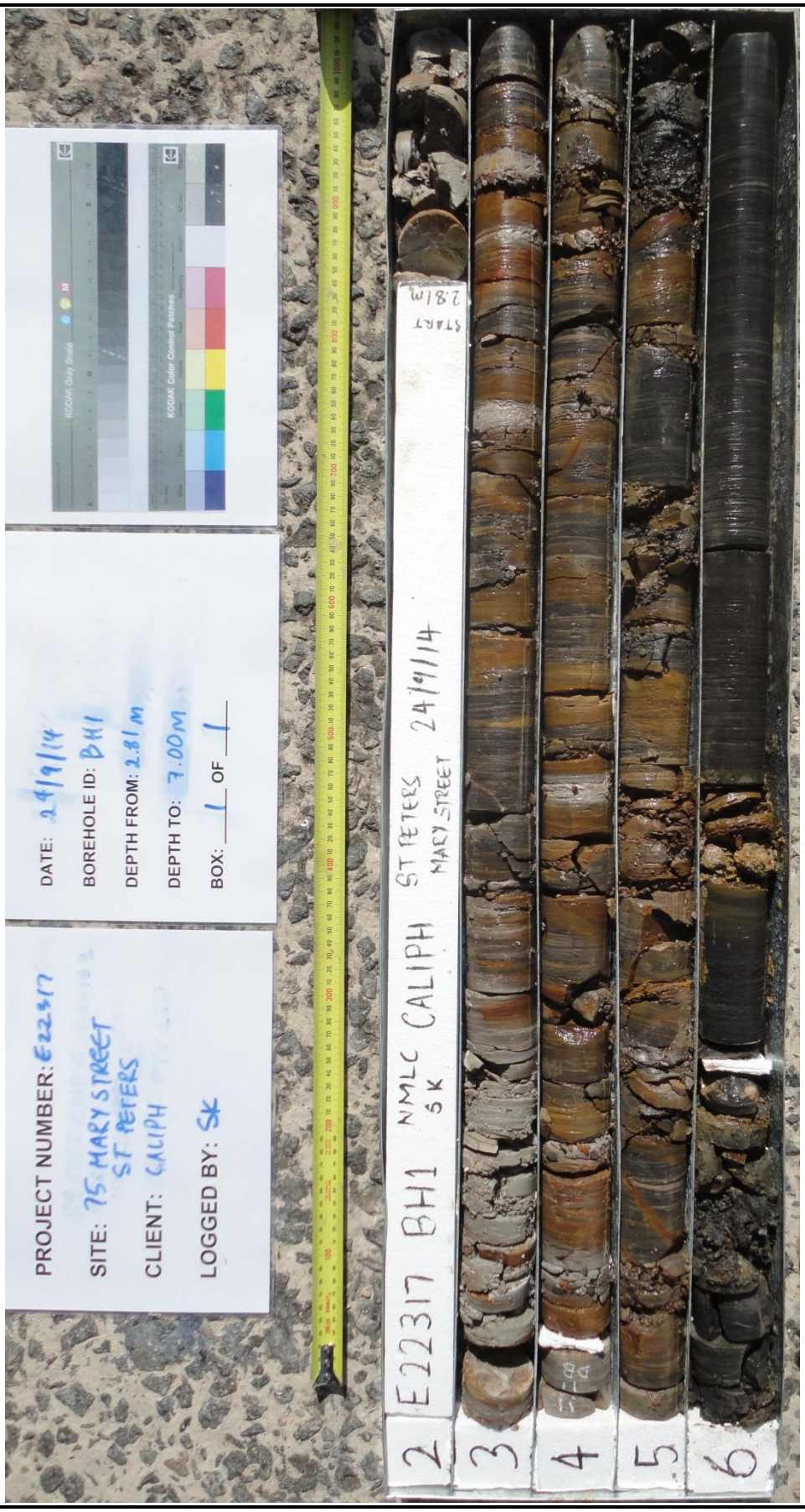
This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH1/MW1/ASS1

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331111.478 m
NORTH: 6246011.117 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 7.00 m

DEPTH RANGE: 2.81 m to 7.00 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 24/9/2014
CHECKED: AM DATE: 9/10/2014



Environmental Investigations Australia
Contamination | Remediation | Geotechnical

BOREHOLE: BH2/MW2/ASS2

Project	New Mixed Development			Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	East	331128.4 m	Date Started	23/9/14
Position	Refer to Figure 2	North	6245971.2 m	Date Completed	23/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 23/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.14				-	FILL: CONCRETE; 140 mm.	-		CONCRETE HARDSTAND
AD/T					BH2-1 ES 0.14-0.40 m PID = 0.1 ppm			-	FILL: Clayey SILT; high plasticity, dark grey, trace medium grained sand, with brick fragments, strong hydrocarbon odour.		-	FILL
				0.50	SPT 0.50 m 1,1,0 N=1 ASS2-1 ES 0.50-0.95 m BH2-2 PID = 1.1 ppm			CH	Silty CLAY; high plasticity, dark grey with orange mottling, strong hydrocarbon odour.	M	VS - S	RESIDUAL SOIL
	E	25/09/14	1		SPT 1.50 m 1,2,6 N=8							
				1.90	ASS2-2 ES 1.50-1.95 m BH2-3 PID = 0.2 ppm			CI	CLAY; medium plasticity, orange with grey mottling, strong hydrocarbon odour.	D	F - St	
		GWNE	2	2.80								
	F							-	SHALE; red-brown, inferred extremely low strength, inferred extremely weathered.			WEATHERED ROCK
				3.15	SPT 3.00 m 21,30 HB N=30/100mm ASS2-3 ES 3.00-3.25 m BH2-4 PID = 1.1 ppm				From 3.15 m, as above, inferred very low strength, inferred distinctly weathered.	-	-	ROCK
	H		3									
				4.26	SPT 4.00 m 5 HB N=5/50mm BH2-5				Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH2/MW2/ASS2

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

Project	New Mixed Development	East	331128.4 m	Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	North	6245971.2 m	Date Started	23/9/14
Position	Refer to Figure 2	Contractor	Traccess Pty Ltd	Date Completed	23/9/14
Job No.	E22317	Drill Rig	Multi-Drill 3000	Logged SK	Date: 23/9/14
Client	Caliph	Inclination	-90°	Checked AM	Date: 9/10/14

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4	4.26		Continuation from non-cored borehole				
NMLC	75-80% RETURN	92	28 (57)	5	4.52		SHALE; bedding dipping 0-5 degrees, pale grey.	DW		4.49: BP 0° PR RF Fe SN 4.54: BP 0° PR RF Fe SN 4.63: BP 0° PR RF Fe SN 4.82: BP 5° PR RF Fe SN 4.82-4.83: JT 20° PR RF Fe SN 4.88-4.89: CS 10 mm, gravel, fine-coarse, angular 5.15: BP 0° PR RF Fe SN 5.21-5.38: CZ 170 mm, gravel, fine-coarse, angular 5.44-5.48: CS 40 mm, gravel, fine-coarse, angular-subangular 5.66-5.69: JT 45° PR RF Fe SN 5.69: BP 0° PR RF Fe SN 5.77-5.82: JT 5 - 70° UN RF Fe SN 5.82-5.84: JT 30 - 45° UN RF Fe SN 5.99: HB 6.00-6.04: CS 40 mm, gravel, coarse, subangular 6.25-6.26: CS 10 mm, gravel, coarse, subangular 6.33: BP 0° PR RF Fe SN 6.37-6.43: DS 60 mm, clayey silt, high plasticity, soft-firm 6.44-6.48: JT 40° PR RF Fe SN 6.51-6.56: CS 50 mm, gravel, medium-coarse, subangular 6.67-6.70: DS 30 mm, clayey silt, high plasticity, soft-firm 6.74: BP 0 - 5° PR RF Fe SN 6.81: BP 0° PR RF Fe SN 6.89-6.93: JT 30 - 60° UN RF Fe SN 6.93-7.00: CS 70 mm, gravel, coarse, angular 7.14-8.94: BPx10 0° PR RF CN avg sp = 300-400 mm	
				6	6.04						
					6.25		CORE LOSS; 210 mm.	-			
				7	7.02		SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, grey with orange iron staining.	DW			
		100	90 (98)	8			SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, dark grey-grey.	SW			
				9	9.00			FR			
				10			Hole Terminated at 9.00 m Target depth reached. Borehole converted to monitoring well.				

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH2/MW2/ASS2

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

Project	New Mixed Development			Sheet	1 OF 1
Location	75 Mary Street, St Peters NSW	East	331128.4 m	Date Started	23/9/14
Position	Refer to Figure 2	North	6245971.2 m	Date Completed	23/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date:23/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS
DT	-		0	0.14				-	FILL: CONCRETE; 140 mm.	-		ID MW2 / Static Water Level
AD/T					BH2-1 ES 0.14-0.40 m PID = 0.1 ppm			-	FILL: Clayey SILT; high plasticity, dark grey, trace medium grained sand, with brick fragments, strong hydrocarbon odour.		-	MW2
				0.50								Gatic Cover
					SPT 0.50 m 1,1,0 N=1 ASS2-1 ES 0.50-0.95 m BH2-2 PID = 1.1 ppm			CH	Silty CLAY; high plasticity, dark grey with orange mottling, strong hydrocarbon odour.			Concrete
	E	25/09/14	1							M	VS - S	
					SPT 1.50 m 1,2,6 N=8							
				1.90	ASS2-2 ES 1.50-1.95 m BH2-3 PID = 0.2 ppm			CI	CLAY; medium plasticity, orange with grey mottling, strong hydrocarbon odour.	D	F - St	
		GWNE	2	2.80								Bentonite
	F							-	SHALE; red-brown, inferred extremely low strength, inferred extremely weathered.			
			3	3.15	SPT 3.00 m 21,30 HB N=30/100mm ASS2-3 ES 3.00-3.25 m BH2-4 PID = 1.1 ppm				From 3.15 m, as above, inferred very low strength, inferred distinctly weathered.	-	-	2x uPVC 50 mm casing
	H											
			4		SPT 4.00 m 5 HB N=5/50mm							
				4.26	BH2-5 C 4.26-7.00 m				SHALE; bedding dipping 0-5 degrees, pale grey.			
				4.52					SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, grey with orange iron staining.			
			5		5.00 m							
NMLC	-	75-80% RETURN	6	6.04						-	-	
				6.25					CORE LOSS; 210 mm.			
									SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, grey with orange iron staining.			
			7	7.02	C 7.00-9.00 m 7.00 m				SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, dark grey-grey.			Sand
			8		7.82 m							1x uPVC 50 mm slotted screen
			9	9.00					Hole Terminated at 9.00 m Target depth reached. Borehole converted to monitoring well.			
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH2/MW2/ASS2

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331128.376 m
NORTH: 6245971.168 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 9.00 m

DEPTH RANGE: 4.26 m to 9.00 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 23/9/2014
CHECKED: AM DATE: 9/10/2014

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BOREHOLE: BH3/MW3/ASS3

Project	New Mixed Development			Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	East	331107.4 m	Date Started	25/9/14
Position	Refer to Figure 2	North	6245935.7 m	Date Completed	25/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 25/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.15				-	FILL: CONCRETE; 150 mm.	-		CONCRETE HARDSTAND
				0.40	BH3-1 ES 0.20-0.40 m PID = 12 ppm ASS3-1 ES 0.40-0.50 m SPT 0.50 m 2,3,6 N=9 BH3-2 PID = 0.8 ppm			-	FILL: CLAY; high plasticity, grey-brown, with brick fragments, strong hydrocarbon odour.	M	-	FILL
AD/T	E	GWNE	1					CH	CLAY; high plasticity, grey with red mottling, mild hydrocarbon odour.	D	St	RESIDUAL SOIL
					SPT 1.50 m 7,7,10 N=17 ASS3-2 BH3-3 PID = 3.6 ppm						VSt	
			2	2.00				-	SHALE; grey with orange iron staining, inferred extremely low strength, inferred extremely weathered.			WEATHERED ROCK
	F			2.50								
	H								From 2.5 m, as above, inferred very low strength, inferred distinctly weathered	-	-	ROCK
			3	3.27	SPT 3.00 m 25 HB N=25/150mm BH3-4 PID = 0.5 ppm				Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH3/MW3/ASS3

Project	New Mixed Development	East	331107.4 m	Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	North	6245935.7 m	Date Started	25/9/14
Position	Refer to Figure 2	Contractor	Traccess Pty Ltd	Date Completed	25/9/14
Job No.	E22317	Drill Rig	Multi-Drill 3000	Logged SK	Date: 9/10/14
Client	Caliph	Inclination	-90°	Checked AM	Date: 9/10/14

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3	*3.27*		Continuation from non-cored borehole				
NMLC	85-90% RETURN	100	20 (47)	4			SHALE; bedding dipping 5-10 degrees, pale grey-grey with medium to high strength ironstone bands up to 60 mm thick.	DW		3.29: DB 3.37-3.39: DS 20 mm, sandy silt, medium plasticity, soft, sand is fine grained 3.43-3.44: DS 10 mm, silt, high plasticity, soft 3.49-3.53: DS 40 mm, silt, high plasticity, soft 3.54-3.87: BPx4 5 - 10° PR RF Fe SN avg sp = 5-30 mm 3.68-3.70: DS 20 mm, silt, high plasticity, soft 3.75-3.82: CS 70 mm, gravel, fine to medium, angular 3.89-3.95: DS 60 mm, silt, high plasticity, soft 4.00-4.04: DS 40 mm, silt, high plasticity, soft 4.12: JT 0 - 20° CU S Fe SN 4.41: BP 5° PR RF Fe SN 4.46-4.48: DS 20 mm, silt, high plasticity, soft 4.48-4.54: CS 60 mm, gravel, fine to medium, angular 4.62-4.67: DS 50 mm, silt, high plasticity, soft 4.67-4.76: DB 4.87: BP 5° PR RF Fe SN 4.95: JT 0 - 20° CU RF Fe SN 5.04-5.08: DS 40 mm, silt, high plasticity, soft 5.11: BP 10° PR RF Fe SN 5.13-5.18: DS 50 mm, silt, high plasticity, soft 5.24-5.25: DS 10 mm, silt, high plasticity, soft 5.25-5.28: CS 30 mm, gravel, fine to medium, angular 5.28-5.32: JT 60° closed 5.33-5.38: CS 50 mm, gravel, fine to medium, angular 5.56: DB 5.62: BP 10° PR RF Fe SN 5.63-5.65: CS 20 mm, gravel, medium to coarse, subangular 5.69: JT 0° ST RF Fe SN 5.73-5.75: DS 20 mm, silt, high plasticity, soft 5.78: BP 5° PR RF Fe SN 5.81-5.95: CZ 140 mm, gravel, fine to medium, angular 6.00-6.08: CS 80 mm, gravel, coarse, angular 6.10-6.26: JT 20 - 90° UN RF Fe SN 6.11-6.16: JT 80° PR RF Fe SN 6.16: BP 5° PR RF Fe SN 6.30-6.52: HB	
				5	*4.56*		SHALE; bedding dipping 5-10 degrees, <1-2 mm thick, average spacing = 1-3 mm, grey-dark grey with orange iron staining.				
		100	12 (31)	6	*6.52*						
				7			Hole Terminated at 6.52 m Target depth reached. Borehole converted to monitoring well.				
				8							
				9							
				10							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH3/MW3/ASS3

Project	New Mixed Development			Sheet	1 OF 1
Location	75 Mary Street, St Peters NSW	East	331107.4 m	Date Started	25/9/14
Position	Refer to Figure 2	North	6245935.7 m	Date Completed	25/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 25/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID / Static Water Level
DT	-		0	0.15				-	FILL: CONCRETE; 150 mm.	-		MW3
AD/T	E	GWNE	1	0.40	BH3-1 ES 0.20-0.40 m PID = 12 ppm ASS3-1 ES 0.40-0.50 m SPT 0.50 m 2,3,6 N=9 BH3-2 PID = 0.8 ppm			-	FILL: CLAY; high plasticity, grey-brown, with brick fragments, strong hydrocarbon odour.	M	-	
								CH	CLAY; high plasticity, grey with red mottling, mild hydrocarbon odour.	D	St	
					SPT 1.50 m 7,7,10 N=17 ASS3-2						VSt	Bentonite 2x uPVC 50 mm casing
	F		2	2.00	BH3-3 PID = 3.6 ppm			-	SHALE; grey with orange iron staining, inferred extremely low strength, inferred extremely weathered.			
				2.50					From 2.5 m, as above, inferred very low strength, inferred distinctly weathered	-	-	
	H		3	3.27	SPT 3.00 m 25 HB N=25/150mm BH3-4 PID = 0.5 ppm C 3.27-4.79 m				SHALE; bedding dipping 5-10 degrees, pale grey-grey with orange iron staining.			
NMLC	-	85-90% RETURN	4		4.30 m							
			5	4.56	C 4.79-6.52 m				SHALE; bedding dipping 5-10 degrees, <1-2 mm thick, average spacing = 1-3 mm, grey-dark grey with orange iron staining.	-	-	Sand 1x uPVC 50 mm slotted screen
					5.40 m							
			6	6.52					Hole Terminated at 6.52 m Target depth reached. Borehole converted to monitoring well.			
			7									
			8									
			9									
			10									

Gatic Cover
Concrete

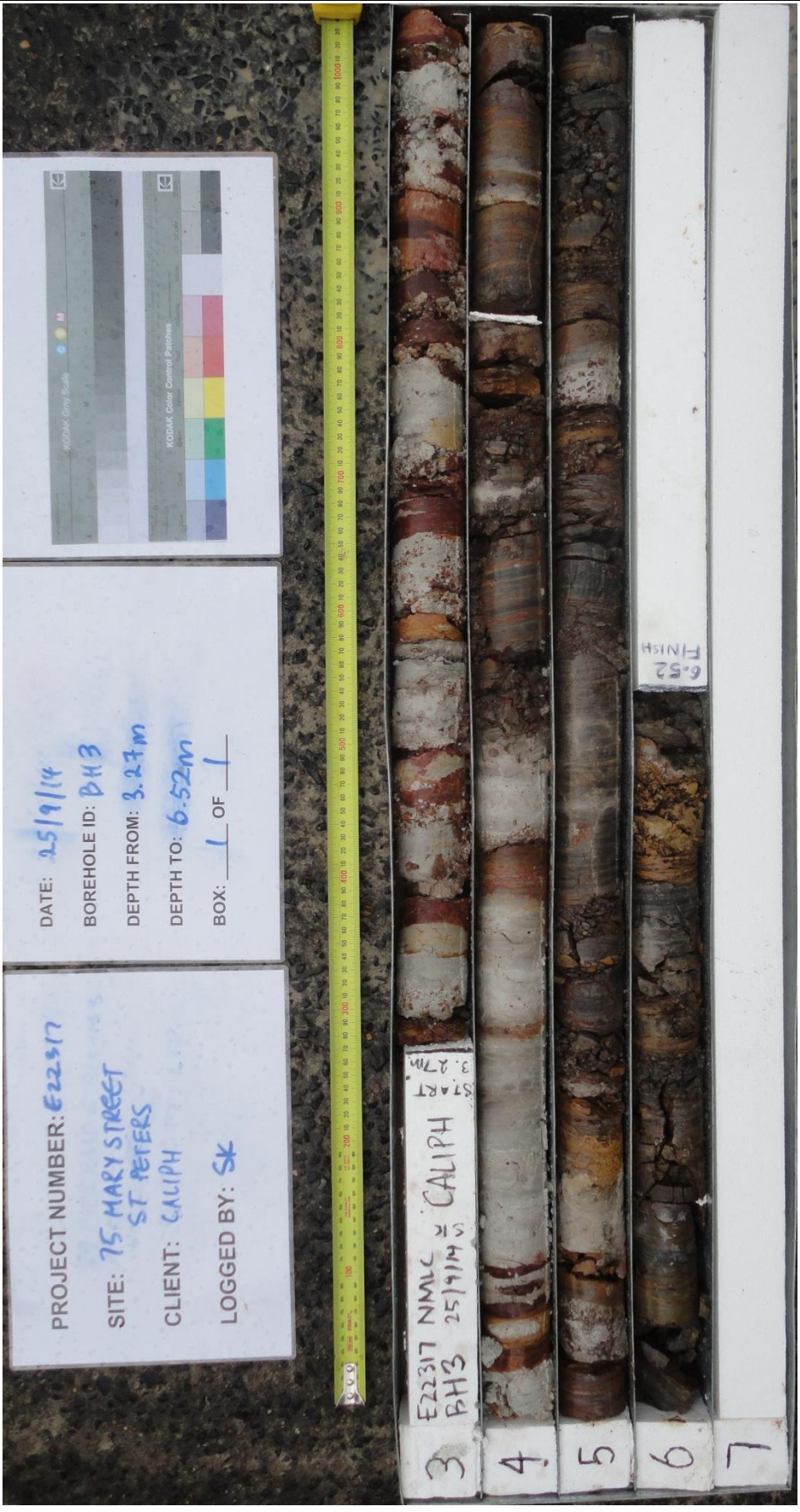
This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH3/MW3/ASS3

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331107.430 m
NORTH: 6245935.749 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 6.52 m

DEPTH RANGE: 3.27 m to 6.52 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 25/9/2014
CHECKED: AM DATE: 9/10/2014



BOREHOLE: BH4/MW4/ASS4

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Project	New Mixed Development	East	331071.8 m	Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	North	6245975.2 m	Date Started	24/9/14
Position	Refer to Figure 2	Contractor	Traccess Pty Ltd	Date Completed	24/9/14
Job No.	E22317	Drill Rig	Multi-Drill 3000	Logged SK	Date: 24/9/14
Client	Caliph	Inclination	-90°	Checked AM	Date: 9/10/14

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	E	25/09/14	0	0.30	BH4-1 ES 0.30-0.40 m PID = 11 ppm SPT 0.50 m 1,2,3 N=5 BH4-2 PID = 180 ppm ASS4-1 ES 1.00-1.20 m SPT 1.50 m 2,2,6 N=8 BH4-3 PID = 122 ppm			-	FILL: ASPHALT; 30 mm.	-	-	ROAD SURFACE
								-	FILL: Silty GRAVEL; medium to coarse, angular gravel, inferred road base material, mild hydrocarbon odour.		-	FILL
			1					CH	Silty CLAY; high plasticity, grey with red mottling, trace fine to medium, subrounded ironstone gravel, trace rootlets, strong hydrocarbon odour.		F	RESIDUAL SOIL
			2	2.50							St	
	F				ASS4-2 ES 2.50-2.70 m			-	SHALE; grey with orange iron staining, inferred extremely low strength, inferred extremely weathered, mild hydrocarbon odour.	W		WEATHERED ROCK
			3	3.00	SPT 3.00 m 30 HB N=30/150mm BH4-4 PID = 14 ppm				From 3.0 m, as above, inferred very low strength, inferred distinctly weathered, no odour.			ROCK
	H		4		ASS4-3 ES 4.30-4.50 m SPT 4.50 m 11,19 HB N=19/150mm BH4-5 PID = 3.2 ppm						-	
				4.90					Continued as Cored Borehole			
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH4/MW4/ASS4

Project	New Mixed Development			Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	East	331071.8 m	Date Started	24/9/14
Position	Refer to Figure 2	North	6245975.2 m	Date Completed	24/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 9/10/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
					4.90		Continuation from non-cored borehole				
NMLC	75-80% RETURN	100	11 (39)	5			SHALE;bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, dark grey-grey with orange iron staining.	DW		4.93: BP 0 - 5° UN RF Fe SN 4.95: BP 0° PR RF Fe SN 5.03-5.04: BPx2 0° PR RF Fe SN 5.05: HB 5.10: DB 5.22: BP 0° PR RF Fe SN 5.26-5.32: JT 60 - 90° CU RF Fe SN 5.29: BP 0 - 5° UN RF Fe SN 5.33-5.39: BPx4 0 - 5° PR RF Fe SN avg sp = 10-20 mm 5.44-5.46: CS 20 mm, gravel, fine-medium, subrounded 5.49-5.51: JT 0 - 30° UN RF Fe SN 5.53: BP 0° PR RF Fe SN 5.58-5.59: DS 10 mm, silt, high plasticity, soft, trace fine-medium, subangular gravel 5.63-5.66: JT 90° PR RF Fe SN 5.64-5.66: JT 30° PR RF Fe SN 5.73-5.74: CS 10 mm, gravel, fine-medium, subrounded 5.74-5.78: JT 40° closed 5.82: BP 0° PR RF Fe SN 5.89-6.12: BPx15 0 - 5° PR RF Fe SN avg sp = 10-20 mm 6.21-6.29: CS 80 mm, gravel, coarse, subangular 6.32: JT 30° PR RF Fe SN 6.36: BP 0° PR RF Fe SN 6.39-6.45: DB 6.45-6.55: DB 6.60-7.91: BPx28 0 - 5° PR RF Fe SN avg sp = 10-100 mm 6.61: JT 15° UN RF Fe SN 6.65-6.70: CS 50 mm, gravel, medium-coarse, angular 6.80-6.82: JT 45° CU RF Fe SN 6.87: JT 15° CU RF Fe SN 6.91: JT 15° UN RF Fe SN 7.00-7.06: JT 45 - 80° UN RF Fe SN 7.64: JT 20° PR RF Fe SN 7.84: DB	
		100	13 (47)	6							
				7	*7.22*		SHALE; bedding dipping 0-5 degrees, <1-1 mm thick, average spacing = <1-3 mm, dark grey-grey with brown iron staining.	SW			
					7.96		Hole Terminated at 7.96 m Target depth reached. Borehole converted to monitoring well.				
				8							
				9							
				10							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH4/MW4/ASS4

Project	New Mixed Development			Sheet	1 OF 1
Location	75 Mary Street, St Peters NSW	East	331071.8 m	Date Started	24/9/14
Position	Refer to Figure 2	North	6245975.2 m	Date Completed	24/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 24/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID / Static Water Level
AD/T	E	25/09/14	0	0.30				-	FILL: ASPHALT; 30 mm.	-	-	MW4
								-	FILL: Silty GRAVEL; medium to coarse, angular gravel, inferred road base material, mild hydrocarbon odour.			Gatic Cover
												Concrete
					BH4-1 ES 0.30-0.40 m PID = 11 ppm SPT 0.50 m 1,2,3 N=5 BH4-2 PID = 180 ppm ASS4-1 ES 1.00-1.20 m			CH	Silty CLAY; high plasticity, grey with red mottling, trace fine to medium, subrounded ironstone gravel, trace rootlets, strong hydrocarbon odour.		F	Bentonite
			1									1x uPVC 50 mm casing
					SPT 1.50 m 2,2,6 N=8 BH4-3 PID = 122 ppm						St	
			2	2.50						W		
	F				ASS4-2 ES 2.50-2.70 m			-	SHALE; grey with orange iron staining, inferred extremely low strength, inferred extremely weathered, mild hydrocarbon odour.			
			3	3.00					From 3.0 m, as above, inferred very low strength, inferred distinctly weathered, no odour.			
	H				SPT 3.00 m 30 HB N=30/150mm BH4-4 PID = 14 ppm						-	
			4									
					ASS4-3 ES 4.30-4.50 m SPT 4.50 m 11,19 HB N=19/150mm							Sand
				4.90	BH4-5 PID = 3.2 ppm C 4.90-6.45 m				SHALE; bedding dipping 0-5 degrees, <1-3 mm thick, average spacing = 2-3 mm, dark grey-grey with orange iron staining.			2x uPVC 50 mm slotted screen
NMLC	-	75-80% RETURN	5							-	-	
			6		6.12 m C 6.45-7.96 m							
			7	7.22	7.30 m				SHALE; bedding dipping 0-5 degrees, <1-1 mm thick, average spacing = <1-3 mm, dark grey-grey with brown iron staining.			
				7.96					Hole Terminated at 7.96 m Target depth reached. Borehole converted to monitoring well.			
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH4/MW4/ASS4

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331071.812 m
NORTH: 6245975.180 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 7.96 m

DEPTH RANGE: 4.90m to 7.96 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 24/9/2014
CHECKED: AM DATE: 9/10/2014

Environmental Investigations Australia
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BOREHOLE: BH5/MW5/ASS5

Project	New Mixed Development			Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	East	331192.6 m	Date Started	23/9/14
Position	Refer to Figure 2	North	6245953.9 m	Date Completed	23/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 23/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	E	25/09/14 GWNE	0	0.30	BH5-1 ES 0.20-0.30 m PID = 80 ppm			-	FILL: gravelly SAND; fine to medium grained, brown, gravel is fine to coarse, subangular, strong hydrocarbon odour.	D	-	ROAD SURFACE
				0.70	BH5-2 D 0.30-0.40 m PID = 52 ppm			-	FILL; Sandy CLAY; high plasticity, brown, sand is fine to medium grained, trace fine to medium, subrounded gravel, with brick fragments, mild hydrocarbon odour.			FILL
			1		ASS5-1 ES 0.40-0.50 m SPT 0.50 m 2,2,2 N=4 BH5-3 PID = 89 ppm			CH	CLAY; high plasticity, grey mottled red, trace fine to medium, subrounded ironstone gravel, trace rootlets, mild hydrocarbon odour.		F	RESIDUAL SOIL
			2	2.30	SPT 1.50 m 3,5,8 N=13 ASS5-2 ES 1.50-1.95 m BH5-4 PID = 138 ppm						St	
	F							-	MUDSTONE; pale brown-orange, inferred extremely low strength, inferred extremely weathered, no odour.	M (<PL)		WEATHERED ROCK
			3	3.00	SPT 3.00 m 13,25,5 HB N=30/160mm BH5-5 PID = 4.1 ppm				From 3.0 m, as above, inferred very low strength, inferred extremely weathered.		-	ROCK
	H		4	4.20	SPT 4.00 m 4 HB N=4/50mm BH5-6							
									Continued as Cored Borehole			
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH5/MW5/ASS5

Project	New Mixed Development	East	331192.6 m	Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	North	6245953.9 m	Date Started	23/9/14
Position	Refer to Figure 2	Contractor	Traccess Pty Ltd	Date Completed	23/9/14
Job No.	E22317	Drill Rig	Multi-Drill 3000	Logged SK	Date: 23/9/14
Client	Caliph	Inclination	-90°	Checked AM	Date: 9/10/14

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4	4.20		Continuation from non-cored borehole				
NMLC	80-85% RETURN	94	56 (63)	5	4.66		MUDSTONE; bedding dipping 0-5 degrees, pale grey-pale brown.	DW		4.30-4.50: BPX5 0 - 5° PR S Fe SN avg sp = 10-100 mm 4.60-4.66: DS 60 mm, silt, high plasticity, soft	
							CORE LOSS; 100 mm.	-			
							MUDSTONE; bedding dipping 0-5 degrees, pale grey-pale brown.	DW		5.10-5.30: JT 50° PR S Fe SN 5.21: BP 0° PR S Fe SN 5.26-5.28: HB 5.34-5.44: BPX3 0° PR S Fe SN avg sp = 50 mm 5.54: JT 10° ST RF Fe SN 5.65-6.00: CZ 350 mm, gravel, coarse, subangular-angular	
				6	6.00		From 6.0 m, as above, pale grey-pale brown with orange iron staining.			6.04: JT 0 - 30° UN RF Fe SN 6.16: BP 0° PR RF Fe SN 6.18-6.20: CS 20 mm, gravel, fine-medium, subrounded 6.23: BP 0° PR RF Fe SN 6.27: BP 0° PR RF Fe SN 6.29-6.33: CS 40 mm, gravel, fine-coarse, subrounded 6.39-6.47: DS 80 mm, silt, high plasticity, soft 6.53: HB 6.59: JT 20° ST RF Fe SN 6.62-6.67: DS 50 mm, silt, high plasticity, firm, trace gravel, medium-coarse, angular 6.74: DB 6.89: BP 0° PR RF Fe SN 7.11-7.22: BPX3 0 - 5° PR RF CN avg sp = 10-100 mm 7.35-7.37: JT 50° PR RF CN 7.37: BP 0° PR RF CN 7.37-7.60: JT 85° PR RF CN 7.47-7.68: BPX8 0 - 5° PR RF CN 7.73-7.75: CS 20 mm, gravel, fine-coarse, angular 7.76: BP 0° PR RF Fe SN 7.86: DB 8.10-8.20: JT 45 - 90° CU RF CN 8.14: BP 5° PR RF CN 8.22-8.40: JT 45 - 80° CU RF CN 8.29: JT 0° PR RF CN 8.42: DB 8.47: BP 10° PR RF CN	
		100	31 (58)	7	6.29		SHALE; bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-3 mm, dark grey-grey with orange iron staining.				
		100	46 (51)	8	8.66			SW			
				9			Hole Terminated at 8.66 m Target depth reached. Borehole converted to monitoring well.			9.58-8.66: DB	
				10							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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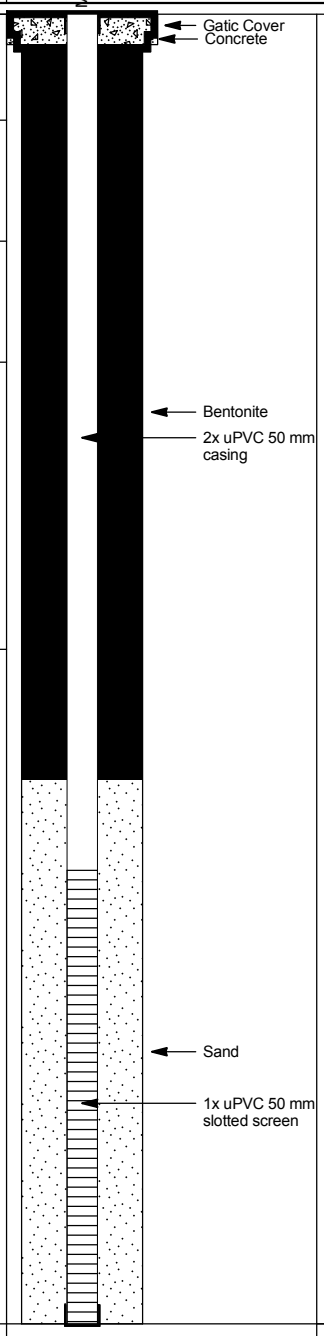
BOREHOLE: BH5/MW5/ASS5

Project	New Mixed Development			Sheet	1 OF 1
Location	75 Mary Street, St Peters NSW	East	331192.6 m	Date Started	23/9/14
Position	Refer to Figure 2	North	6245953.9 m	Date Completed	23/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 23/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY
AD/T	E	25/09/14	0	0.30	BH5-1 ES 0.20-0.30 m PID = 80 ppm BH5-2 D 0.30-0.40 m PID = 52 ppm ASS5-1 ES 0.40-0.50 m SPT 0.50 m 2,2,2 N=4 BH5-3 PID = 89 ppm			-	FILL: gravelly SAND; fine to medium grained, brown, gravel is fine to coarse, subangular, strong hydrocarbon odour.	D	-
				0.70				-	FILL; Sandy CLAY; high plasticity, brown, sand is fine to medium grained, trace fine to medium, subrounded gravel, with brick fragments, mild hydrocarbon odour.		
			1		SPT 1.50 m 3,5,8 N=13 ASS5-2 ES 1.50-1.95 m BH5-4 PID = 138 ppm			CH	CLAY; high plasticity, grey mottled red, trace fine to medium, subrounded ironstone gravel, trace rootlets, mild hydrocarbon odour.		F St
		GWNE	2	2.30				-	MUDSTONE; pale brown-orange, inferred extremely low strength, inferred extremely weathered, no odour.	M (<PL)	
	F		3	3.00	SPT 3.00 m 13,25,5 HB N=30/160mm BH5-5 PID = 4.1 ppm				From 3.0 m, as above, inferred very low strength, inferred extremely weathered.		-
	H		4	4.20	SPT 4.00 m 4 HB N=4/50mm BH5-6 C 4.20-6.00 m				MUDSTONE; bedding dipping 0-5 degrees, pale grey-pale brown.		
NMLC	-	80-85% RETURN		4.66					CORE LOSS; 100 mm.	-	-
			5		5.45 m				MUDSTONE; bedding dipping 0-5 degrees, pale grey-pale brown.		
			6	6.00	C 6.00-6.80 m				From 6.0 m, as above, pale grey-pale brown with orange iron staining.		
				6.29					SHALE; bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-3 mm, dark grey-grey with orange iron staining.		
			7		C 6.80-8.66 m 6.89 m						
			8		7.86 m						
				8.66					Hole Terminated at 8.66 m Target depth reached. Borehole converted to monitoring well.		
			9								
			10								

PIEZOMETER DETAILS
ID Static Water Level
MW5



This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH5/MW5/ASS5

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331192.569 m
NORTH: 6245953.870 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 8.66 m

DEPTH RANGE: 4.20 m to 8.66 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 23/9/2014
CHECKED: AM DATE: 9/10/2014-

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BOREHOLE: BH6

Project	New Mixed Development			Sheet	1 OF 2
Location	75 Mary Street, St Peters NSW	East	331100.0 m	Date Started	25/9/14
Position	Refer to Figure 2	North	6245974.3 m	Date Completed	25/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 25/9/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.19				-	FILL: CONCRETE; 190 mm.	-	-	CONCRETE HARDSTAND
AD/T	E	GWNE	1	0.40	BH6-1 ES 0.20-0.40 m PID = 0.2 ppm SPT 0.50 m 1,2,3 N=5 BH6-2 PID = 0.5 ppm			-	FILL: Gravelly CLAY; medium plasticity, brown-dark brown, gravel is fine to medium, subangular, with brick fragments, no odour.	M	-	FILL
								CH	CLAY; high plasticity, grey-brown mottled red, trace fine to medium, subrounded ironstone gravel, no odour.	D	F	RESIDUAL SOIL
				1.80	SPT 1.50 m 3,3,8 N=11 BH6-3 PID = 0.4 ppm			-	SHALE; red-grey with orange iron staining, inferred extremely low strength, inferred extremely weathered, no odour.		St	
	F		2							-	-	WEATHERED ROCK
				3.00					From 3.0 m, as above, inferred very low strength, inferred distinctly weathered.			
	H		3	3.30	SPT 3.00 m 10 HB N=10/20mm BH6-4 SPT 3.30 m 5 HB N=5/40mm BH6-5				From 3.3 m, as above, pale grey.			ROCK
				3.64					Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH6

Project	New Mixed Development			Sheet	2 OF 2
Location	75 Mary Street, St Peters NSW	East	331100.0 m	Date Started	25/9/14
Position	Refer to Figure 2	North	6245974.3 m	Date Completed	25/9/14
Job No.	E22317	Contractor	Traccess Pty Ltd	Logged SK	Date: 9/10/14
Client	Caliph	Drill Rig	Multi-Drill 3000	Checked AM	Date: 9/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
					3.64		Continuation from non-cored borehole				
NMLC	80-90% RETURN	96	28 (55)	4	*3.74*		SHALE; bedding dipping 0-10 degrees, <1-1 mm thick, pale grey-grey with medium to high strength ironstone bands up to 20 mm thick.	DW		3.64-3.74: DB	
							CORE LOSS; 50 mm.	-		3.86-4.84: BPx10 0 - 10° PR RF Fe SN avg sp = 20-100 mm	
							SHALE; bedding dipping 0-10 degrees, <1-1 mm thick, pale grey-grey with medium to high strength ironstone bands up to 80 mm thick.	DW		4.22-4.25: CS 30 mm, gravel, fine-coarse, angular 4.37-4.41: HB 4.48: JT 15° PR RF Fe SN 4.52: JT 0 - 90° ST RF Fe SN 4.56-4.64: DS 80 mm, silt, high plasticity, stiff 4.66: JT 20° PR RF Fe SN 4.70: JT 0 - 40° UN RF Fe SN 4.72-4.77: DS 50 mm, silt, high plasticity, stiff 4.91: DB 4.94-5.02: DB 5.02-5.04: DS 20 mm, silt, high plasticity, stiff 5.14-6.29: BPx12 0 - 10° PR RF Fe SN avg sp = 30-100 mm 5.27: JT 30° closed 5.37-5.44: DS 70 mm, silt, high plasticity, stiff 5.62: JT 20° UN RF Fe SN 5.66: JT 30° PR RF Fe SN 5.71: JT 10° PR RF Fe SN 5.78-5.81: CS 30 mm, gravel, fine-coarse, angular-subangular 6.00-6.08: HB 6.15-6.16: JTx2 0 - 30° CU RF Fe SN 6.22-6.24: JT 5 - 30° CU RF Fe SN 6.22-6.34: JT 80 - 90° UN RF Fe SN 6.33-6.40: CS 70 mm, gravel, fine-coarse, angular-subangular 6.40: JT 30° PR RF Fe SN 6.42: JT 20 - 30° UN RF Fe SN 6.50-7.33: BPx9 0 - 10° PR RF CN avg sp = 30-100 mm 6.55-6.57: CS 20 mm, gravel, fine-coarse, angular-subangular 6.61: JT 20° PR RF CN 6.68: JT 10° PR RF CN 6.75-6.78: JT 30° PR RF CN 6.86: JT 40° PR RF CN 6.89-6.91: CS 20 mm, gravel, fine-coarse, angular-subangular 7.06: JT 0 - 20° UN RF CN 7.13-7.21: JT 60° PR RF CN 7.42-7.54: CZ 120 mm, gravel, fine-coarse, angular-subangular 7.54-7.60: DB	
				5	*5.05*		SHALE; bedding dipping 0-10 degrees, <1-1 mm thick, average spacing = 1-3 mm, dark grey-grey with orange iron staining.				
		100	25 (44)	6	*5.92*		SHALE; bedding dipping 0-10 degrees, <1-2 mm thick, average spacing = <1-3 mm, dark grey-grey.	SW			
				7	*7.73*			FR			
				8			Hole Terminated at 7.73 m Target depth reached. Backfilled with drilling spoil. Concrete capped.				
				9							
				10							

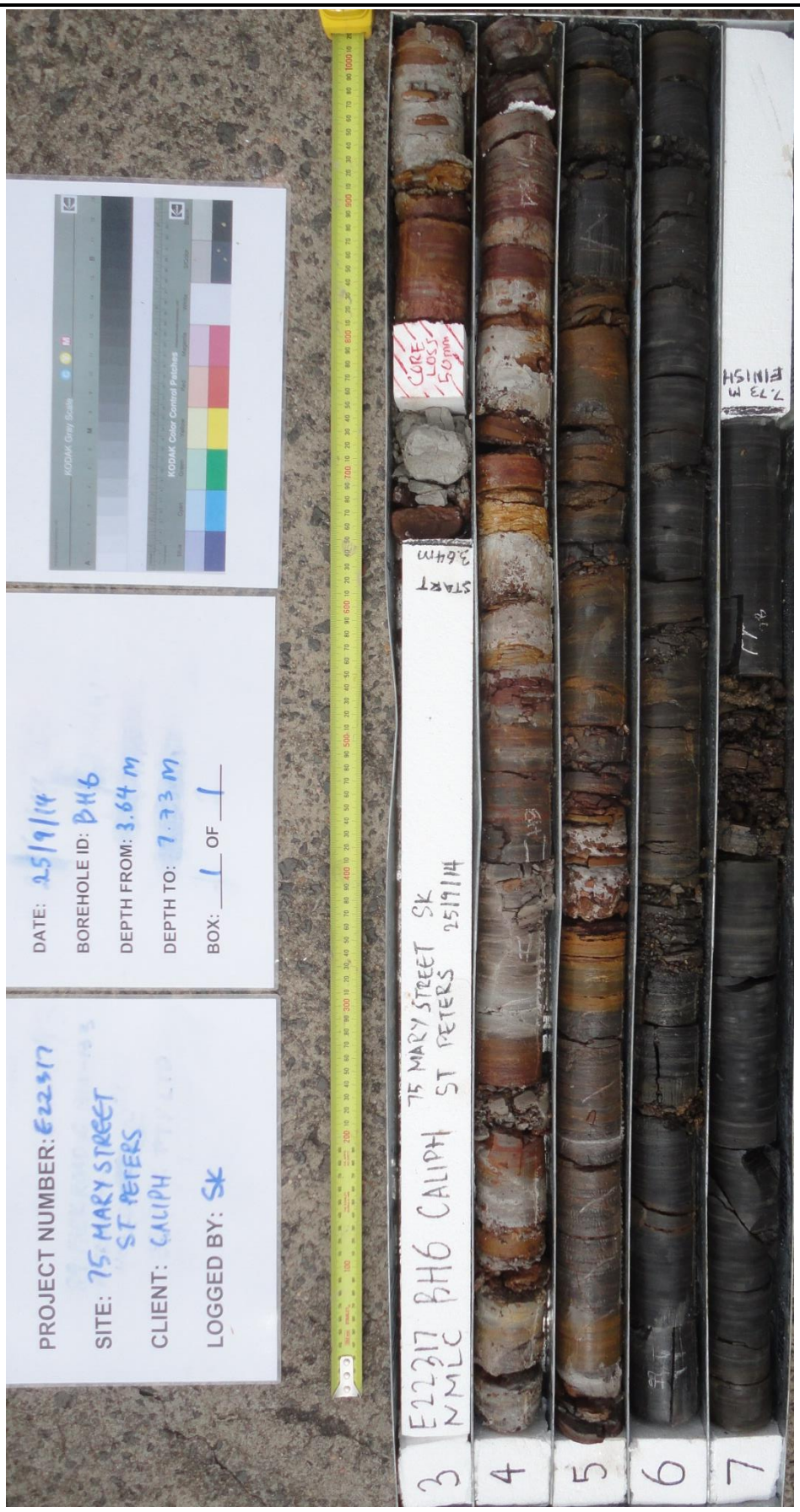
This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH6

CLIENT: Caliph
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 75 Mary Street, St Peters, NSW
JOB NO: E22317

EAST: 331100.047 m
NORTH: 6245974.262 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 7.73 m

DEPTH RANGE: 3.64 m to 7.73 m
DRILL RIG: Multi-Drill 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 25/9/2014
CHECKED: AM DATE: 9/10/2014



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EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

DRILLING/EXCAVATION METHOD

HA	Hand Auger	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
DTC	Diatube Coring	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
NDD	Non-destructive digging	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
AS*	Auger Screwing	RC	Reverse Circulation	HMLC	Diamond Core - 63mm
AD*	Auger Drilling	PT	Push Tube	BH	Tractor Mounted Backhoe
*V	V-Bit	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
*T	TC-Bit, e.g. ADT	JET	Jetting	EE	Existing Excavation
ADH	Hollow Auger	WB	Washbore or Bailer	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration/ excavation possible with little effort from equipment used.

M **Medium resistance.** Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.

H **High resistance.** Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.

R **Refusal/ Practical Refusal.** No further progress possible without risk of damage or unacceptable wear to equipment used.

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

WATER

Water level at date shown

Water inflow

Partial water loss

Complete water loss

GROUNDWATER NOT OBSERVED — Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.

GROUNDWATER NOT ENCOUNTERED — Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm
seating 30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
Sampling	
DS	Disturbed Sample
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
FP	Field Permeability test over section noted
FVS	Field Vane Shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket Penetrometer test expressed as instrument reading in kPa
WPT	Water Pressure tests
DCP	Dynamic Cone Penetrometer test
CPT	Static Cone Penetration test
CPTu	Static Cone Penetration test with pore pressure (u) measurement

RANKING OF VISUALLY OBSERVABLE CONTAMINATION AND ODOUR (for specific soil contamination assessment

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recevered}}{\text{Lengh of core run}} \text{ x } 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\Sigma \text{ Length ofcylindrical core recevered}}{\text{Lengh of core run}} \text{ x } 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\Sigma \text{Axial Lenghts of core} > 100\text{mm}}{\text{Lengh of core run}} \text{ x } 100$$

MATERIAL BOUNDARIES

———— = inferred boundary

- - - - - - - - = probable boundary

— ?— ?— ?— ? = possible boundary

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METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

	FILL		ORGANIC SOILS (OL, OH or Pt)		CLAY (CL, CI or CH)
	COUBLES or BOULDERS		SILT (ML or MH)		SAND (SP or SW)
	GRAVEL (GP or GW)	Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay			

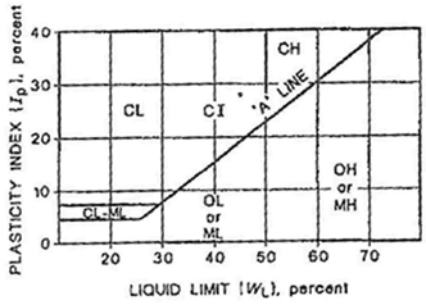
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/tactile methods.

PARTICLE SIZE CHARACTERISTICS

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6 to 20 mm
	Fine	2 to 6 mm
SAND	Coarse	0.6 to 2 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2mm
SILT		0.002 to 0.075 mm
CLAY		<0.002 mm

PLASTICITY PROPERTIES



USCS SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 50% by dry mass less than 63mm is greater than 0.075mm	More than 50% of coarse grains are >2.mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines.
		GM	Silty gravel, gravel-sand-silt mixtures.
		GC	Clayey gravel, gravel-sand-clay mixtures.
	More than 50% of coarse grains are <2 mm	SW	Well graded sand and gravelly sand, little or no fines.
		SP	Poorly graded sand and gravelly sand, little or no fines.
		SM	Silty sand, sand-silt mixtures.
		SC	Clayey sand, sandy-clay mixtures.
FINE GRAINED SOILS More than 50% by dry mass less than 63mm is less than 0.075mm	Liquid Limit less < 50%	ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL	Organic silts and organic silty clays of low plasticity.
	Liquid Limit > than 50%	MH	Inorganic silts of high plasticity.
		CH	Inorganic clays of high plasticity.
		OH	Organic clays of medium to high plasticity.
		PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

Moisture content of cohesive soils may also be described in relation to plastic limit (WP) or liquid limit (WL) [» much greater than, > greater than, < less than, « much less than].

CONSISTENCY

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0. to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	< 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Density	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Trace	Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: ≤ 5% Fine grained soil: ≤15%
Some	Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: 5 - 12% Fine grained soil: 15 - 30%

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TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

CLASSIFICATION AND INFERRED STRATIGRAPHY
Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

STRENGTH

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa) #	Field Guide
EL	Extremely Low	< 0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

 # Rock Strength Test Results

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

◀ Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($Is_{(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. UCS is typically 10 to 30 x $Is_{(50)}$, but can be as low as 5 MPa.

ROCK MATERIAL WEATHERING

Symbol		Term	Field Guide
RS		Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
EW		Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Distinctly Weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW.
	MW		
SW		Slightly Weathered	Rock slightly discoloured but shows little or no change of strength relative to fresh rock.
FR		Fresh	Rock shows no sign of decomposition or staining.

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ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

ROCK MATERIAL DESCRIPTION

Layering

Term	Description
Massive	No layering apparent
Poorly Developed	Layering just visible; little effect on properties
Well Developed	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering

Structure

Term	Spacing (mm)
Thinly laminated	<6
Laminated	6 – 20
Very thinly bedded	20 – 60
Thinly bedded	60 – 200
Medium bedded	200 – 600
Thickly bedded	600 – 2,000
Very thickly bedded	> 2,000

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Foliation	FL	Repetitive planar structure parallel to the shear direction or perpendicular to the direction of higher pressure, especially in metamorphic rock, e.g. Schistosity (SH) and Gneissosity.
Contact	CO	The surface between two types or ages of rock.
Cleavage	CL	Cleavage planes appear as parallel, closely spaced and planar surfaces resulting from mechanical fracturing of rock through deformation or metamorphism, independent of bedding.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Decomposed Seam/ Zone	DS/DZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Schistocity	SH	The foliation in schist or other coarse grained crystalline rock due to the parallel arrangement of platy or prismatic mineral grains, such as mica.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	Pl	Consistent orientation	Polished	Pol	Shiny smooth surface
Curved	Cu	Gradual change in orientation	Slickensided	SL	Grooved or striated surface, usually polished
Undulating	Un	Wavy surface	Smooth	S	Smooth to touch. Few or no surface irregularities
Stepped	St	One or more well defined steps	Rough	RF	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	Ir	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

Orientation: **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

Coating	Abbr.	Description
Clean	CN	No visible coating or infilling
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)
Veneer	VNR	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy

DEFECT APERTURE

Aperture	Abbr.	Description
Closed	CL	Closed.
Open	O	Without any infill material.
Infilled	-	Soil or rock i.e. clay, talc, pyrite, quartz, etc.

APPENDIX B

LABORATORY TEST CERTIFICATES

SOIL CHEMICAL PROPERTIES REPORT

Client:	Environmental Investigations	**Source:**	BH2-3 1.5-1.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No.:**	S1184-SCP
Job No.:	14-655	**Lab No.:**	14810 (S1184)

Test Procedure:		
☑	AS1289 4.2.1	Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method
☑	AS1289 4.3.1	Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method
☑	AS 1289 4.4.1	Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material
☐	RTA T123	pH value of a soil (electrometric method)
☐	RTA T185	Resistivity of sands and granular road construction materials
☐	RTA T200	Chloride content of roadbase
☑	RTA T1010	Quantitative determination of chlorides in soil
☐	RTA T1011	Quantitative determination of sulphates in soil
☐	BS1377(1990 pt.3)	Water soluble sulphate content
☐	TAI B117	Sulphides Present

Sampling:	Sampled by Client	**Date Sampled:**	24/09/2014
Preparation:	Prepared in accordance with AS1289 1.1		

Sulphides Present	-
Sulphate content (ppm)	424.1
Sulphate content (%)	0.04
Chloride ion content (ppm)	106.4
Chloride ion content (%)	0.01
pH	5.4
Electrical Conductivity (uS/cm)	-
Mean Resistivity Ω.m	120
(Resisitivity) Density ratio (R_D)	90
(Resisitivity) Density index (I_D)	-

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Authorised Signatory:

7/10/2014

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

POINT LOAD STRENGTH INDEX REPORT

AS4133 4.1

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	PO Box 215 St Peters, NSW, 2044	**Storage History:**	Core Boxes
Project:	PGI - 75 Mary Street, St Peters NSW (E22317)	**Report No:**	S1188-PLT
Job No:	14-655	**Date Tested:**	7/10/2014

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client **Date Sampled:** 23-25/09/2014

Preparation: Prepared in accordance with the test method

Sample Number	Borehole ID	Depth (m)	Sample Description	Test Type	Average Width (mm)	Platen Seperation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S1188	BH1	3.46-3.57	Siltstone	Diametral	-	52.0	0.01	0.00	0.00	
				Axial	52.0	42.0	0.30	0.11	0.11	
S1189	BH1	6.65-6.75	Siltstone	Diametral	-	52.0	0.65	0.24	0.24	
				Axial	52.0	38.0	0.67	0.27	0.27	
S1190	BH2	5.00-5.15	Siltstone	Diametral	-	52.0	0.04	0.01	0.02	
				Axial	52.0	42.0	0.06	0.02	0.02	
S1191	BH2	7.00-7.13	Siltstone	Diametral	-	47.0	0.31	0.14	0.13	
				Axial	52.0	33.0	0.14	0.06	0.06	
S1192	BH2	7.82-7.92	Siltstone	Diametral	-	52.0	0.35	0.13	0.13	
				Axial	52.0	44.0	0.72	0.25	0.25	
S1193	BH3	4.30-4.40	Shale	Diametral	-	52.0	0.07	0.03	0.03	
				Axial	52.0	45.0	0.31	0.10	0.11	
S1194	BH3	5.40-5.50	Siltstone	Diametral	-	52.0	0.03	0.01	0.01	
				Axial	52.0	48.0	0.04	0.01	0.01	
S1195	BH4	6.12-6.21	Siltstone	Diametral	-	52.0	0.19	0.07	0.07	
				Axial	52.0	39.0	0.36	0.14	0.14	
S1196	BH4	7.30-7.40	Siltstone	Diametral	-	52.0	0.75	0.28	0.28	
				Axial	52.0	40.0	0.40	0.15	0.15	
S1197	BH5	5.45-5.55	Siltstone	Diametral	-	52.0	0.04	0.01	0.02	
				Axial	52.0	46.0	0.04	0.01	0.01	

Comments:

Authorised Signatory:

7/10/2014

NATA Accredited Laboratory Number: 14874

Chris Lloyd

Date:

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

POINT LOAD STRENGTH INDEX REPORT

AS4133 4.1

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	PO Box 215 St Peters, NSW, 2044	**Storage History:**	Core Boxes
Project:	PGI - 75 Mary Street, St Peters NSW (E22317)	**Report No:**	S1198-PLT
Job No:	14-655	**Date Tested:**	7/10/2014

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client **Date Sampled:** 23-25/09/2014

Preparation: Prepared in accordance with the test method

Sample Number	Borehole ID	Depth (m)	Sample Description	Test Type	Average Width (mm)	Platen Seperation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S1198	BH5	6.89-7.00	Siltstone	Diametral	-	52.0	0.11	0.04	0.04	
				Axial	52.0	40.0	0.12	0.05	0.05	
S1199	BH5	7.86-8.00	Siltstone	Diametral	-	52.0	0.27	0.10	0.10	
				Axial	52.0	45.0	0.39	0.13	0.13	
S1200	BH6	5.19-5.29	Siltstone	Diametral	-	52.0	0.03	0.01	0.01	
				Axial	52.0	42.0	0.07	0.03	0.03	
S1201	BH6	6.08-6.16	Siltstone	Diametral	-	47.0	0.34	0.15	0.15	Failure through defect
				Axial	52.0	*	*	*	*	*Unable to perform test due to diametral sample failure.
S1202	BH6	7.60-7.73	Siltstone	Diametral	-	52.0	0.50	0.18	0.19	
				Axial	52.0	38.0	0.58	0.23	0.23	

Comments:

Authorised Signatory:

7/10/2014

NATA Accredited Laboratory Number: 14874

Chris Lloyd

Date:

MACQUARIE GEOTECH

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Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

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3 Watt Drive
BATHURST NSW 2795

SOIL CLASSIFICATION REPORT

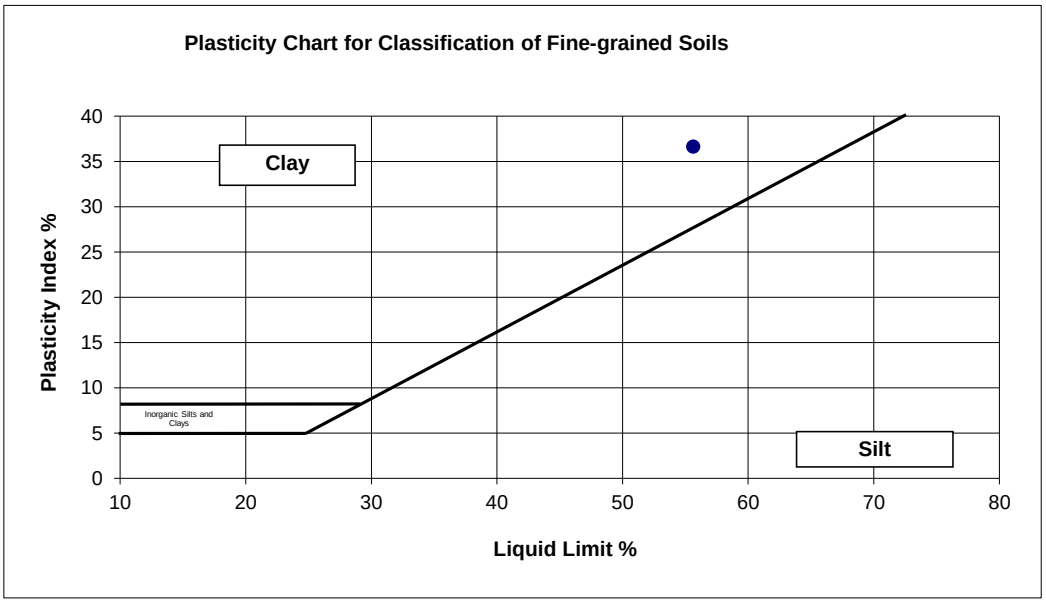
Client:	Environmental Investigations	**Source:**	BH1 - 3 - 1.5-1.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No:**	S1182-PI
Job No:	14-655	**Lab No:**	S1182

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	24.09.14
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	56	**Linear Shrinkage (%):**	-
Plastic Limit (%):	19	**Field Moisture Content (%):**	17.2
Plastic Index:	37		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: NA

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Date:

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Location: 8/10 Bradford St, Alexandria NSW 2015
Site No.: 22365

Facility

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CLASSIFICATION REPORT

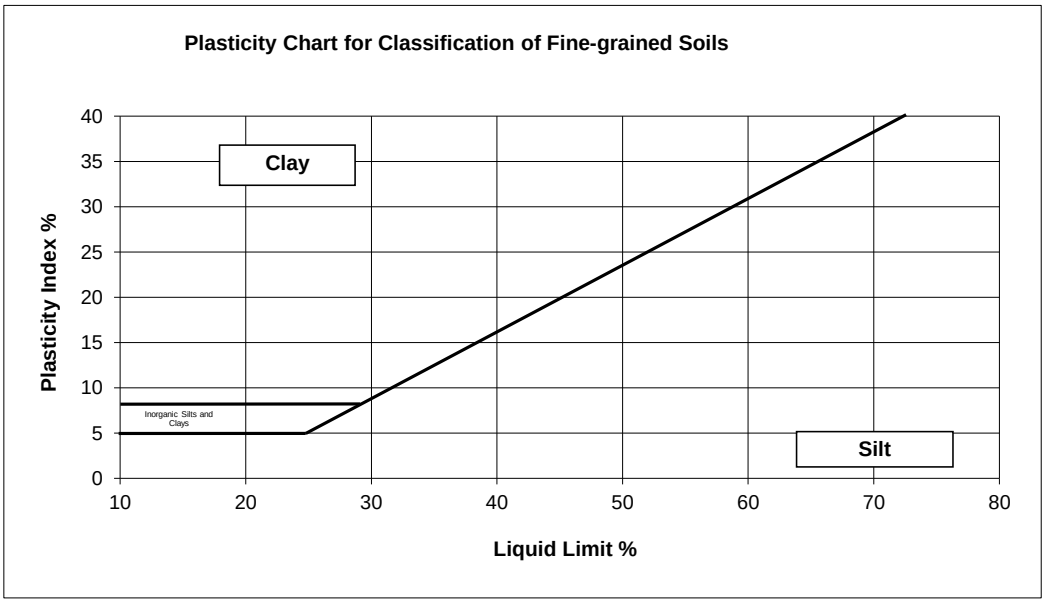
Client:	Environmental Investigations	**Source:**	BH2 - 2 - 0.5-0.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No:**	S1183-PI
Job No:	14-655	**Lab No:**	S1183

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	24.09.14
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	64	**Linear Shrinkage (%):**	-
Plastic Limit (%):	23	**Field Moisture Content (%):**	42.9
Plastic Index:	41		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: NA

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Site No.: 22365

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3 Watt Drive
Bathurst NSW 2795

SOIL CLASSIFICATION REPORT

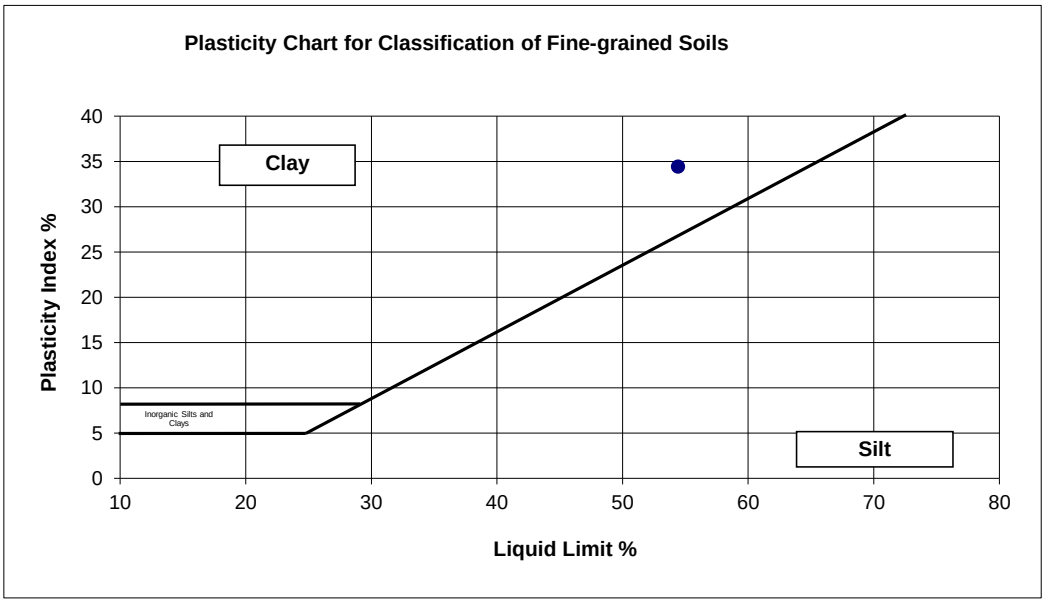
Client:	Environmental Investigations	**Source:**	BH3 - 3 - 1.5-1.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No:**	S1185-PI
Job No:	14-655	**Lab No:**	S1185

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	24.09.14
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	54	**Linear Shrinkage (%):**	-
Plastic Limit (%):	20	**Field Moisture Content (%):**	18.3
Plastic Index:	34		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: NA

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Site No.: 22365

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3 Watt Drive
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SOIL CLASSIFICATION REPORT

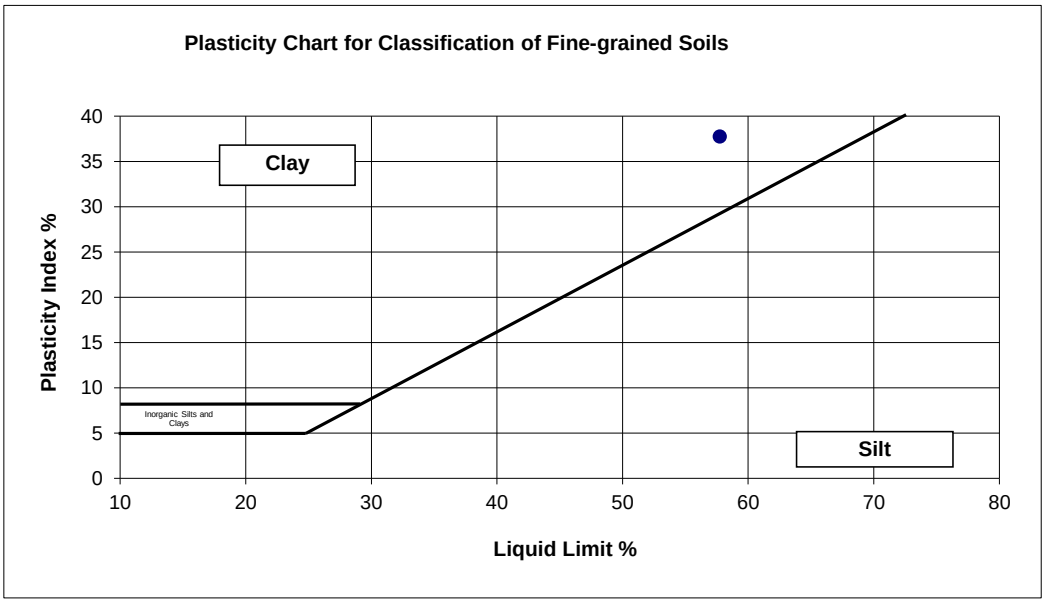
Client:	Environmental Investigations	**Source:**	BH4 - 2 - 0.5-0.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No:**	S1186-PI
Job No:	14-655	**Lab No:**	S1186

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	24.09.14
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	58	**Linear Shrinkage (%):**	-
Plastic Limit (%):	20	**Field Moisture Content (%):**	35.4
Plastic Index:	38		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: NA

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Site No.: 22365

Facility

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CLASSIFICATION REPORT

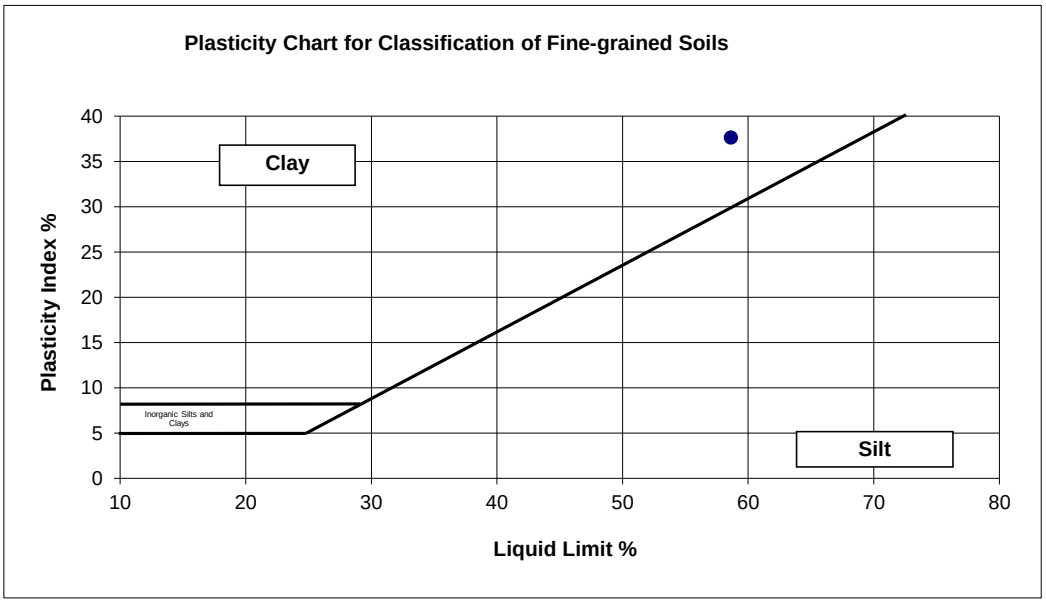
Client:	Environmental Investigations	**Source:**	BH5 - 4 - 1.5-1.95m
Address:	PO Box 215 St Peters, NSW, 2044	**Sample Description:**	silty CLAY
Project:	75 Mary Street, St Peters (E22317)	**Report No:**	S1187-PI
Job No:	14-655	**Lab No:**	S1187

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	24.09.14
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	59	**Linear Shrinkage (%):**	-
Plastic Limit (%):	21	**Field Moisture Content (%):**	19.3
Plastic Index:	38		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: NA

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Site No.: 22365

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Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

APPENDIX C

IMPORTANT INFORMATION

Important Information

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Environmental Investigations ("EI"). The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

EI has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. EI has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, EI 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 EI.

GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

LIMITATIONS OF SITE INVESTIGATION

The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. EI should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that EI be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

REPRODUCTION OF REPORTS

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. EI 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 EI or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

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