Attachment A17

Preliminary Geotechnical Report
757-763 George Street, Haymarket

SAMPRIAN PTY LTD

Preliminary Geotechnical Investigation Report

757-763 George Street, Haymarket NSW

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8 September 2020

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Revision	Details	Date	Amended By
	Original	3 October 2014	
1	Updated design advice	7 October 2014	MG
2	Updated architectural drawings	7 July 2020	SK
3	Updated client details and drawings	8 September 2020	SK

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1. Introduction

1.1 Background

At the request of Samprian Pty Ltd (the Client), EI Australia (EI) has carried out a Preliminary Geotechnical Investigation Report (PGI) for the proposed development at 757-763 George Street, Haymarket 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 proposed mixed use development. The original fieldwork was carried out in accordance with the scope of works outlined in our proposal referenced P12702.1, dated 18 August 2014.

An Environmental Site Assessment (ESA) for the Site was also undertaken by EI and is presented separately in the report, referenced as E22293 AA. The ESA provides more information on environmental impact of the soils and groundwater at the site from past industrial use.

On 7 September 2020, the Client provided revised architectural plans to update the report as part of Revision 3.

1.2 Proposed Development

The following documents, supplied by the Client, were used to assist with the preparation of this PGI report:

- Architectural drawings prepared by Grimshaw Architects LLP – Project No. 19287:
  - Drawing No. A03-1000 to A03-1004, A03-1006, A03-1010 to A03-1012, A03-1021, A03-1031, A03-1033, A06-1000, Rev. 4, dated 31 August 2020
  - Drawing No. A06-1010 and A06-1011, Rev. 3, dated 31 August 2020
  - Drawing No. A07-1000, Rev. 1, dated 31 August 2020
- Detailed site survey plan prepared by Lawrence Group Pty Ltd – Job No. 142937, Drawing No. DETL-001/A, Sheet 1 of 3, dated 21 August 2014;
- An unreferenced area schedule, dated 27 August 2020.

Based on the provided documents, EI understands that the proposed development involves the demolition of the existing buildings and the construction of a thirty-two hotel and retail building overlying a two-level basement. The Finished Floor Level (FFL) of the lowest basement level is proposed as RL 3.0m. A Bulk Excavation Level (BEL) of RL 2.7m AHD has been assumed to allow for the construction of a basement slab; hence, an excavation depth of approximately 9.5 m Below Existing Ground Level (BEGL) has been estimated across the site. Locally deeper excavations may be required for footings, lift overrun pits, crane pads, and service trenches. The proposed basement extends up to the all site boundaries.

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:

- Dilapidation Surveys;

- Excavation methodologies and monitoring requirements;
- Groundwater considerations;
- Vibration considerations;
- Excavation support requirements, including geotechnical design parameters for retaining walls and shoring systems;
- Building foundation options, including;
  - Lot classification in accordance with AS2870:2011 for shallow footing design;
  - Preliminary design parameters.
  - Earthquake loading factor in accordance with AS1170.4:2007; and
  - Subgrade preparation and earthworks requirements.
- The requirement for additional geotechnical works.

1.4 Scope of Works

The scope of works for the PGI included:

- Preparation of a Work Health and Safety Plan;
- Review of relevant geological maps for the project area;
- Site walkover inspection by a Geotechnical Engineer to assess topographical features and site conditions;
- Scanning of proposed borehole locations for buried conductive services using a licensed service locator with reference to Dial Before You Dig (DBYD) plans;
- Concrete coring through existing concrete hardstand at two borehole locations (BH1/MW1 and BH2);
- Auger drilling of two boreholes (BH1/MW1 and BH2) by a track-mounted drill rig using solid-stem, continuous flight augers equipped with ‘Tungsten-Carbide’ (T-C) bit. BH1/MW1 and BH2 were augered to 7.2 m (RL 4.6m AHD) and 7.3 m (RL 4.7m AHD) BEGL, respectively.
  - Standard Penetration Testing (SPT) was carried out (as per AS 1289.6.3.1-2004), where possible, during auger drilling of the boreholes to assess soil strength/relative densities.
  - Measurements of groundwater seepage/levels, where possible, in the augered sections of the boreholes during and shortly after completion of auger drilling;
  - The strength of the bedrock in the augered sections of the boreholes was assessed by observation of the auger penetration resistance using a T-C drill bit and examination of the recovered rock cuttings. It should be noted that rock strengths assessed from augered boreholes are approximate and strength variances can be expected.
- Continuation of BH1/MW1 and BH2 using NMLC diamond coring techniques to termination depths of 14.95 m (RL -3.15m AHD) and 12.00 m (RL 0.0m AHD) BEGL, respectively. The rock core photographs are presented in **Appendix A**;
- Borehole BH1/MW1 was converted into a groundwater monitoring well to allow for long-term groundwater monitoring;

- Backfilling the remaining borehole with drilling spoil in the reverse order of excavation and capping of the surface with quick-set concrete; and
- Soil and rock samples were sent to Resource Laboratories, which is a National Australian Testing Authority (NATA) accredited laboratory, for testing and storage.
- Preparation of this PGI report.

An EI Geotechnical Engineer was present full-time onsite to set out the borehole locations, direct the testing and sampling, log the subsurface conditions and record groundwater levels.

1.5 Constraints

The PGI was limited by the preliminary intent of the investigation and the presence of existing site structures and vehicles at the time of the investigation. The discussions and advice presented in this report are preliminary and intended to assist in the preparation of initial designs for the proposed development 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.

2. Site Description

2.1 Site Description and Identification

The site identification details and associated information are presented in **Table 2-1** below while the site locality is shown on **Figure 1.** An aerial photograph of the site is presented in **Plate 1** below.

Table 2-1 Summary of Site Information

Information	Detail
Street Address	757-763 George Street, Haymarket NSW 2000
Lot and Deposited Plan (DP) Identification	Lot 1 in DP 1031645 and Lot 11 in DP 70261
Brief Site Description	The site is irregular in shape. It is located on the corner of George Street and Valentine Street. The site is currently occupied by two 2 to 3-storey brick mixed commercial and residential structures with no basement levels. On the north-western corner is concrete hardstand parking with access from George Street. All paved surfaces were found to be in good condition. George Street is a NSW Transport Roads and Maritime Services (RMS) asset. The proposed development should consider the NSW Department of Planning *'Development near rail corridors and busy roads'* interim guidelines.
Site Area	The site area is approximately 1030 m^2 (based on the provided area schedule referenced above).

Plate 1: Aerial photograph of the site (source: SIX Maps, accessed on 24 June 2020)

2.2 Local Land Use

The site is situated within an area of mixed metropolitan use. Current uses on surrounding land at the time of our presence on site are described in **Table 2-2** below.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	A nine to twelve-storey mixed commercial and residential brick building with six levels of basement car parking. The final finished floor of last basement level is given at RL -7.8 mAHD, based on structural drawings provided by Samprian Pty Ltd. The basement footprint is expected to extend to the site boundary.
East	George Street, with three-storey commercial brick buildings with two basement levels and Christ Church St. Laurence beyond. George Street is a RMS asset.
South	Valentine Street, with two to four-storey mix use brick buildings beyond.
West	A ten-storey mix use brick building (UTS facility) with a two-level basement car park adjacent to the building. The basement footprint is known to extends close to the western site boundary.

2.3 Regional Setting

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

Table 2-3 Topographic and Geological Information

Attribute	Description
Topography	The regional topography consists of gently undulating rises on Wianamatta Group Shales and Hawkesbury Sandstone. Local relief to 30 m, slopes are usually <5%. Broad rounded crests and ridges with gently inclined slopes. Local topography slopes downwards to the northwest, with the site sloping down George Street at 5° to 10° and down Valentine Street at <5°.
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 Hawkesbury Sandstone, which typically comprises Medium to coarse-grained quartz sandstone with very minor shale and laminite lenses. Pells, Braybrooke and Och have produced a map entitled *Map and Selected Details of Near Vertical Structural Details in the Sydney CBD* which indicates that the Pittman LVII dyke, trending south east to north west may intersect the proposed basement excavation. The Martin Place Joint Swarm is approximately 50m north west of the site, which trends north east to south west. Samprian Pty Ltd provided as built construction drawing ‘Footing Plan & Details’ Project No. 9371-5 Rev D for 743-755 George Street, Haymarket which has a ‘clay dyke trending north west to south east through the basement.
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 a combination of the Blacktown and Gymea 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 for the Blacktown Landscape. Soils are generally shallow to moderately deep (30-100 cm) yellow earths and earthy sands on crests; shallow (< 20 cm) siliceous sands on leading edges of benches; localised

Attribute	Description
	gleyed podzolic soils and yellow podzolic soils on shale lenses; shallow to moderately deep (< 1 m) siliceous sands and leached sands along drainage lines for the Gymea Landscape. Land is dominantly intensive residential and light and heavy industry, or urban residential. Landscape limitations include moderately reactive, highly plastic subsoil and poor soil drainage, or localised steep slopes, high soil erosion, rock outcrop, shallow highly permeable soil.
Acid Sulfate Soills (ASS)	In accordance with the Sydney Local Environmental Plan 2012 Acid Sulfate Soils Map – Sheet ASS_015, the site falls within a category classified as Class 5 Acid Sulfate Soils (ASS). An acid sulfate soil assessment would be required where works are within 500 m of adjacent Class 1, 2, 3 or 4 land that is below 5 m AHD and by which the water table is likely to be lowered below 1 m AHD on adjacent Class 1, 2, 3 or 4 land.

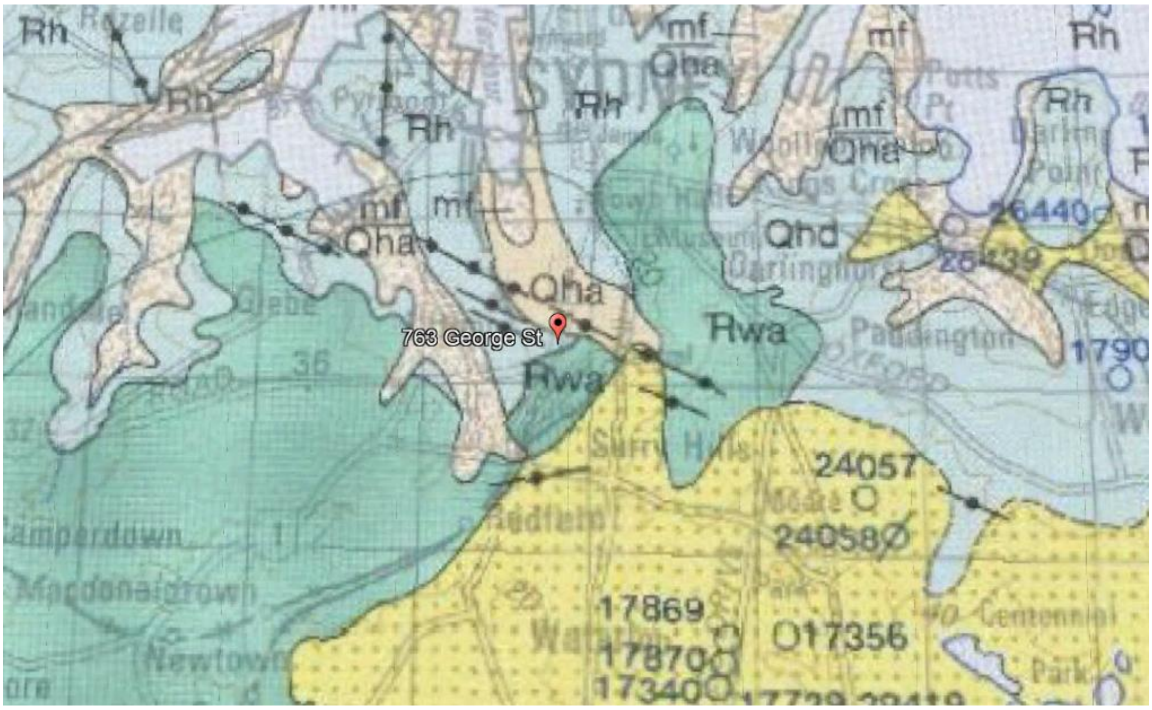

Plate 2: Excerpt of geological map showing location of site.

3. Assessment Results

3.1 Stratigraphy

For the development of a site-specific geotechnical model, the observed stratigraphy of heterogeneous fill from an infilled former basement (BH2 only) overlying a residual soil and weathered bedrock profile has been grouped into five 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 Subsurface Conditions

Unit	Material[2]	Depth to Top of Unit (m BEGL)[1]	RL of Top of Unit (m AHD)[1]	Observed Thickness (m)	Comments
1	**Fill**	0	12.0 to 11.8	0.8 (BH1) to 7.25 (BH2)	Concrete overlying fine to medium grained silty sand and sandy clay, low plasticity. Fill includes brick, concrete and shale and sandstone. At 6.0 m in BH2 a brick layer was encountered, consistent with the base of an in filled basement. Deep fill in BH2 is associated with infill of former basement. Fill is inferred to be uncontrolled and poorly compacted.
2	**Residual Soil**	0.8 (BH1 only)	11.0	2.2	Stiff, high plasticity clay with trace fine to medium grained sand, becoming stiff, medium plasticity silty clay with trace rootlets. SPT N values range from 11 to 12.
3	**Extremely Weathered Sandstone**	2.2 (BH1 only)	9.6	3.8	Generally extremely weathered, extremely low to very low strength, fine to medium grained sandstone.
4	**Distinctly Weathered Sandstone**	6.0 to 7.3	6.0 to 4.5	1.1 to 1.55	Generally distinctly weathered, very low to low strength sandstone. 0-5º bedding, <1 mm thick. Crushed seams up to 10 mm thick and decomposed seams up to 60 mm thick. Unit 4 is classified as Class V Sandstone in accordance with Pells (2004).
5	**Slightly Weathered to Fresh Sandstone**	7.55 to 8.35	4.25 to 3.65	>7.4 [2]	Slightly weathered to fresh, medium to high strength sandstone. 0-30º bedding, <1-5 mm thick. Two joint sets were observed one dipping at 60-80º and the second at 0-20º. Unit 5 is classified as Class IV to III Sandstone in accordance with Pells (2004).

Note 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.

Note 2 Observed up to borehole termination depth in BH1 and BH2.

3.2 Groundwater Observations

No groundwater seepage inflows were observed during the drilling of BH1/MW1 and BH2.

Groundwater measurements taken during the monitoring visit are presented in **Table 3-2**.

Table 3-2 Groundwater Levels

Borehole ID	Date of Observation	Depth to Groundwater (mBGL)
BH1/MW1	18-08-2014	Dry
	01-10-2014	4.95

3.3 Test Results

Two soil samples were selected for laboratory testing to assess the following:

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

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

Selected rock core samples were tested by Resource Laboratories to determine Point Load Strength Index (I_{s50}) 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 Soil Laboratory Test Results

Test/ Sample ID		BH1-4 (1.5-1.95 m BGL)	BH1-6 (4.5-4.95 m BGL)
Unit		Unit 2	Unit 3
Material description [1]		SILTY CLAY	CLAY
Atterberg Limits	Liquid Limit (%)	47	-
	Plastic Limit (%)	15	-
	Plasticity Index (%)	32	-
Moisture Content (%)		17.1	-
Soil Aggressivity	pH	5.5	5.2
	Electrical Conductivity (µS/cm)	46	78
	Sulfate SO_4 (mg/kg)	160	620
	Chloride Cl (mg/kg)	10	30

Note 1 More detailed descriptions of the subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**.

4. Recommendations

4.1 Geotechnical Issues

Based on the results of the assessment, we consider the following to be the main geotechnical issues for the proposed development:

- Potential for the Pittman LVII dyke to be present. Dykes within the Sydney CBD are associated with extremely weathered vertical features, highly fractured rock, groundwater inflow and high lateral stresses. The Martin Place Joint Swarm also has the potential to affect the site. This too may mean a reduction in allowable bearing pressures, increased water inflow, unstable rock faces due to stress relief and adverse jointing.
- Deep fill profile in BH2 as the result of the infilling of a former basement associated with a former building.
- Basement excavation retention to prevent potential lateral deflections and ground loss as a result of excavations. The two neighbouring sites have existing basement excavations which may have temporary or permanent shoring support extending into the site.
- Foundation design for proposed new building loads.
- The proposed basement excavation encountering seepage from the rock interface.

4.2 Dilapidation Surveys

Prior to excavation and construction, we recommend that detailed dilapidation surveys be carried out on all structures and infrastructures surrounding the site that falls within the zone of influence of the excavation to allow assessment of the recommended vibration limits and protect the client against spurious claims of damage. The zone of influence of the excavation is defined by a distance back from the excavation perimeter of twice the total depth of the excavation. The reports would provide a record of existing conditions prior to commencement of the work. A copy of each report should be provided to the adjoining property owner who should be asked to confirm that it represents a fair assessment of existing conditions. The reports should be carefully reviewed prior to demolition and construction.

4.3 Neighbouring Buildings

Prior to any final design or excavation, we recommend that the basement and footings of the adjoining neighbouring buildings be investigated.

4.4 Excavation Methodology

4.4.1 Excavation Assessment

Prior to any excavation commencing, we recommend that reference be made to the Safe Work Australia Excavation Work Code of Practice, dated August 2019.

EI assumes that the proposed development will require a BEL of RL 2.7m for the basement, or an excavation depth of about 9.5m BEGL. Locally deeper excavations for footings, service trenches, crane pads and lifts overrun pits may be required.

Based on the borehole logs, the proposed basement excavations will therefore extend through all units as outlined in **Table 3-1** above. As such, an engineered retention system must be installed prior to excavation commencing.

Units 1, 2 and 3 could be excavated using buckets of large earthmoving Hydraulic Excavators, particularly if fitted with ‘Tiger Teeth’. Excavation of Units 4 and 5 may present hard or heavy ripping, or “hard rock” excavation conditions. Ripping would require a high capacity and heavy bulldozer for effective production. Wear and tear should also be allowed for. The use of a smaller size bulldozer will result in lower productivity and higher wear and tear, and this should be allowed for. Alternatively, hydraulic rock breakers, rock saws, ripping hooks or rotary grinders could be used, though productivity would be lower and equipment wear increased, and this should be allowed for.

Should rock hammers be used for the excavation of the bedrock, excavation should commence away from the adjoining structures and the transmitted vibrations monitored to assess how close the hammer can operate to the adjoining structures while maintaining transmitted vibrations within acceptable limits. To fall within these limits, we recommend that the size of rock hammers do not exceed a medium sized rock hammer, say 900 kg, such as a Krupp 580, and be trialled prior to use. The transmitted vibrations from rock hammers should be measured to determine how close each individual hammer can operate to the adjoining buildings.

The vibration measurements can be carried out using either an attended or an unattended vibration monitoring system. An unattended vibration monitoring system must be fitted with an alarm in the form of a strobe light or siren or alerts sent directly to the site supervisor to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor must be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds set limits outlined by a vibration monitoring plan. Reference should be made to **Appendix C** for a guide to acceptable limits of transmitted vibrations.

If it is found that the transmitted vibrations by the use of rock hammers are unacceptable, then it would be necessary to change to a smaller excavator with a smaller rock hammer, or to a rotary grinder, rock saws, jackhammers, ripping hooks, chemical rock splitting and milling machines. Although these are likely to be less productive, they would reduce or possibly eliminate risks of damage to adjoining properties through vibration effects transmitted via the ground. Such equipment would also be required for detailed excavation, such as footings or service trenches, and for trimming of faces. Final trimming of faces may also be completed using a grinder attachment rather than a rock breaker in order to assist in limiting vibrations. The use of rotary grinders generally generates dust and this may be supressed by spraying with water.

To assist in reducing vibrations and over-break of the sandstone, we recommend that initial saw cutting of the excavation perimeters through the bedrock may be provided using rock saw attachments fitted to the excavator. Rock sawing of the excavation perimeter has several advantages as it often reduces the need for rock bolting as the cut faces generally remain more stable and require a lower level of rock support than hammer cut excavations, ground vibrations from rock saws are minimal and the saw cuts will provide a slight increase in buffer distance for use of rock hammers. However, the effectiveness of such approach must be confirmed by the results of vibration monitoring.

Groundwater seepage monitoring should be carried out during bulk excavation works and prior to finalising the design of a pump out facility. Outlets into the stormwater system will require Council approval.

Furthermore, any existing buried services, which run below the site, will require diversion prior to the commencement of excavation or alternatively be temporarily supported during excavation, subject to permission or other instructions from the relevant service authorities. Enquiries should also be made for further information and details, such as invert levels, on the buried services.

4.4.2 Excavation Monitoring

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

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 nearby structures and services.

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. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructures. Measurements should be taken in the following sequence:

- Before commencing installation of retaining structures where appropriate to determine the baseline readings. Two independent sets of measurements must be taken confirming measurement consistency;
- After installation of the retaining structures, but before commencement of excavation;
- After excavation to the first row of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to any subsequent rows of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to the base of the excavation;
- After de-stressing and removal of any rows of supports or anchors; and
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the latter.

4.5 Groundwater Considerations

Groundwater was observed in MW1 at a depth of 4.95m, which is above the assumed BEL.

Due to the low permeability of the bedrock profile any groundwater inflows into the excavation should not have an adverse impact on the proposed development or on the neighbouring sites and should be manageable. However, we expect that some groundwater inflows into the excavation along the soil/rock interface and through any defects within the sandstone bedrock (such as jointing, and bedding planes, etc.) particularly following a period of heavy rainfall. The initial flows into the excavation may be locally high, but would be expected to decrease considerably with time as the bedding seams/joints are drained. We recommend that monitoring of seepage be implemented during the excavation works to confirm the capacity of the drainage system.

We expect that any seepage that does occur will be able to be controlled by a conventional sump and pump system. We recommend that a sump-and-pump system be used both during construction and for permanent groundwater control below the basement floor slab.

We note that high permeability conditions may be possible if a dyke occurs within proposed basement excavation.

In the long term, drainage should be provided behind all basement retaining walls, around the perimeter of the basement and below the basement slab. The completed excavation should be inspected by the hydraulic engineer to confirm that adequate drainage has been allowed for. Drainage should be connected to the sump-and-pump system and discharging into the stormwater system. The permanent groundwater control system should take into account any possible soluble substances in the groundwater which may dictate whether or not groundwater can be pumped into the stormwater system.

The design of drainage and pump systems should take the above issues into account along with careful ongoing inspections and maintenance programs.

4.6 Excavation Retention

4.6.1 Support Systems

From a geotechnical perspective, it is critical to maintain the stability of all adjacent structures and infrastructures during demolition, excavation and construction works.

Based on the provided architectural plans, the proposed basement extends up to the site boundaries. Based on the depth of the excavation, the encountered subsurface conditions and limited setbacks, temporary batters are not possible for this site. Unsupported vertical cuts of the soil are not recommended for this site as these carry the risk of potential collapse especially after a period of wet weather. Collapse of the material may result in injury to personnel and/or damage to nearby structures/infrastructures and equipment.

An engineered shoring wall is required to support the entire excavation, and should be installed prior to excavation. For this site, we recommend the following retention systems:

- Based on the provided documents, the basement of 749 George Street to the north extends up to the shared northern boundary along the west. Also based on EI’s projects on 187-189 Thomas Street to the west, the basement of this building is known to extend up to the shared western boundary for the majority of the boundary length. It may be possible to excavate adjacent to the basements to the northwest and west without support; however, details of the adjoining basements must be obtained to confirm this possibility.
    - As the proposed basement is shallower than the basement to the north, the surcharge loads of the proposed building on the neighbouring building must be considered. Piles may be required.
    - As the proposed building is deeper than the basement to the west, the design of excavation support should consider loading from neighbouring structures and the requirement for underpinning be assessed where excavations in rock extend below adjacent building foundation levels.
    - Detailed survey of the relative positions, levels and working loading of neighbouring basements and footings should be acquired prior to final design. The detailed survey should be used to accurately model the interaction of the proposed development with existing structures in the vicinity of the site using finite element software.
- Deep fill was encountered in BH2, which is likely to be associated with a previously existing basement which was backfilled with uncontrolled fill. Where this deep uncontrolled fill is

expected, such as near BH2, a suitable shoring system such as an anchored/propped contiguous pile wall will be required, with mass concrete in between the piles, socketed below BEL. Further investigations must be completed to assess the extent of this deep fill.

- Anchored and/or propped soldier pile wall with mass concrete in between the piles socketed below BEL. These soldier piles may be possible along the eastern and southern elevations of the site, and along the eastern half of the northern elevation, given that the deep fill is not encountered on these sides.

Working platforms may also be required. We can complete the design of the working platform, if commissioned to do so.

Due to the presence of the basement structures adjacent to the site, anchor installation may not be possible and internal props may be required.

The existence of significant horizontal in-situ stresses in bedrock, particularly in the Sydney basin, is well established. The release of such stresses during the basement excavation may cause adverse impact on the stability of the excavation faces and thus increase the movements. Monitoring of several deep excavations within sandstone and shale in the Sydney region indicates that the lateral displacement at the top of the excavation is generally between 0.5mm to 2mm per meter depth of excavation. As the maximum depth of excavation into sandstone is of about 10m, a lateral deflection at the crest of the excavation between 5mm to 20mm can be expected which will reduce in a stepped fashion to zero at the bulk excavation level. Monitoring of the lateral movement as the excavation progresses is recommended. An assessment of such movements and their impact can be carried out using finite element software such as PLAXIS.

Bored piles may be possible in clayey soil. However, given the encountered deep “uncontrolled” fill, collapse of the sides of the pile holes may occur in these areas if bored piers are used for this site. Temporary/sacrificial steel liners with tremmie methods may be required to support the pier holes. An alternative method, which would be more expensive, is the use of grout-injected (CFA) piles. EI recommends the drilling of trial bored piers at the site to assess their suitability. Due to the presence of obstructions within the fill, it is important to maintain the verticality of the shoring piles. Should the piles be out of position, this will affect internal layout/clearances which may require remedial works.

Tremie pumps may be required where high groundwater seepage inflows are present during the drilling of the bored piles. However, relatively large capacity piling rigs will be required for drilling through the sandstone bedrock. The proposed pile locations should take into account the presence of buried services. Further advice should be sought from prospective piling contractors who should be provided with a copy of this report.

4.6.2 Excavation adjacent to RMS Assets

Reference should be made to the RMS Geotechnical Technical Direction (GTD) 2012/001 dated April 2012, with regards to excavation/shoring adjacent to George Street. This document outlines requirements for excavations adjacent to RMS infrastructure and includes the level of geotechnical investigation required, dilapidation surveying, instrumentation and monitoring during construction, trigger levels and contingency plans.

Instrumentation (e.g. inclinometers) and monitoring is typically required where the excavation exceeds 3 m in height (for cantilevered shoring walls) or 6 m in height (for anchored or propped shoring walls). A geotechnical monitoring plan may be required by RMS prior to construction for this site.

As the site of the proposed development lies adjacent to both RMS assets, the asset owners may require further assessment of the potential impact of the proposed development on their assets. In order to assess the latter, a 2D numerical model using a commercially available computer program, such as WALLAP and/or PLAXIS, will be required. This model will enable the assessment of the potential impact of the proposed development on the RMS assets and predict the likely movements in the shoring wall. EI can provide such a service if commissioned to do so.

4.6.3 Retaining Wall Design Parameters

The following parameters may be used for static design of temporary and permanent retaining walls at the subject site:

- Conventional free-standing cantilever walls which support areas where movement is of little concern (i.e. where only gardens or open areas are to be retained), may be designed using a triangular lateral earth pressure distribution and an ‘active’ earth pressure coefficient, K_a, as shown in **Table 4-1;**
- Cantilevered walls, where the tops of which are restrained by the floor slabs of the permanent structure or which support movement sensitive elements, should be designed using a triangular lateral earth pressure distribution and an ‘at rest’ earth pressure coefficient, K_o, as shown in **Table 4-1** below.
- For progressively anchored or propped walls where minor movements can be tolerated (provided there are no buried movement sensitive services), we recommend the use of a trapezoidal earth pressure distribution of 6H kPa for soil, where H is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system, tapering to nil at top and bottom;
- For progressively anchored or propped walls which support areas which are highly sensitive to movement (such as areas where movement sensitive structures or infrastructures or buried services are located in close proximity), we recommend the use of a trapezoidal earth pressure distribution of 8H kPa for soil, where ‘H’ is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system, tapering to nil at top and bottom;
- All surcharge loading affecting the walls (including from construction equipment, construction loads, adjacent high level footings, etc.) should be adopted in the retaining wall design as an additional surcharge using an ‘at rest’ earth pressure coefficient, Ko, of 0.58;
- The retaining walls should be designed as drained and measures are to be taken to provide complete and permanent drainage behind the walls. Strip drains protected with a non-woven geotextile fabric should be used behind the shotcrete infill panels for soldier pile walls. Alternatively, for the contiguous pile walls, weepholes comprising 20mm diameter, slotted PVC pipes installed into holes or gaps between adjacent piles at 1.2m centres (horizontal and vertical), may be used. The embedded pipes must, however, be wrapped with a non-woven geotextile fabric (such as Bidim A34) to act as a filter against subsoil erosion;
- For piles embedded into Unit 5 or better, the allowable lateral toe resistance values outlined in **Table 4-1** below may be adopted. These values assume excavation is not carried out within the zone of influence of the wall toe and the rock does not contain adverse defects etc. The upper 0.3m depth of the socket should not be taken into account to allow for tolerance and disturbance effects during excavation.
- If temporary anchors extend beyond the site boundaries, then permission from the neighbouring properties would need to be obtained prior to installation. Also, the presence

of neighbouring basements and/or services and their levels must be confirmed prior to finalising anchor design**.**

- Anchors should have their bond length within Unit 4 or better. For the design of anchors bonded into Unit 4 or better, the allowable bond stress value outlined in **Table 4-1** below may be used, subject to the following conditions:
    1. Anchor bond lengths of at least 3m behind the ‘active’ zone of the excavation (taken as a 45 degree zone above the base of the excavation) is provided;
    2. Overall stability, including anchor group interaction, is satisfied;
    3. All anchors should be proof loaded to at least 1.33 times the design working load before locked off at working load. Such proof loading is to be witnessed by and engineer independent of the anchoring contractor. We recommend that only experienced contractors be considered for anchor installation with appropriate insurances;
    4. If permanent anchors are to be used, these must have appropriate corrosion provisions for longevity.

Table 4-1 Geotechnical Design Parameters

Material [1]		Unit 1 Fill	Unit 2 Residual Soil	Unit 3 Extremely Weathered Sandstone	Unit 4 Distinctly Weathered Sandstone	Unit 5 Slightly Weathered to Fresh Sandstone
RL of Top of Unit (m AHD) [2]		**12.0 to 11.8**	**11.0**	**9.6**	**6.0 to 4.5**	**4.25 to 3.65**
Bulk Unit Weight (kN/m^3)		**18**	**20**	**23**	**24**	**24**
Friction Angle, ϕ’ (°)		**25**	**25**	**36**	**-**	**-**
Earth Pressure Coefficients	At rest, K_o [3]	0.58	0.58	0.41	-	-
	Active, K_a [3]	0.41	0.41	0.26	-	-
	Passive, K_p [3]	-	-	-	-	-
Allowable Bearing Pressure (kPa) [5]		-	-	-	1000	3500
Allowable Shaft Adhesion (kPa) [4, 5]	in Compression	-	-	-	100	350
	in Uplift	-	-	-	50	175
Allowable Toe Resistance (kPa)		-	-	-	100	350
Allowable Bond Stress (kPa)		-	-	-	50	250
Earthquake Site Risk Classification		▪ AS 1170.4:2007 indicates an earthquake subsoil class of Class C_e.(Shallow Soil) ▪ AS 1170.4:2007 indicates that the hazard factor (z) for Sydney is 0.08.				

Notes:

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

2 Approximate levels of top of unit at the time of our investigation. Levels may vary across the site.

3 Earth pressures are provided on the assumption that the ground behind the retaining walls is horizontal.

4 Side adhesion values given assume there is intimate contact between the pile and foundation material and should achieve a clean socket roughness category R2 or better. Design engineer to check both ‘piston pull-out’ and ‘cone liftout’ mechanics in accordance with AS4678-2002 Earth Retaining Structures.

5 To adopt these parameters we have assumed that:

- Footings have a nominal socket of at least 0.3m, into the relevant founding material;
- For piles, there is intimate contact between the pile and foundation material (a clean socket roughness category of R2 or better);
- Potential soil and groundwater aggressivity will be considered in the design of piles and footings;
- Piles should be drilled in the presence of a 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;
- The bases of all pile, pad and strip footing excavations are cleaned of loose and softened material and water is pumped out prior to placement of concrete;
- The concrete is poured on the same day as drilling, inspection and cleaning.
- The allowable bearing pressures given above are based on serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the minimum footing dimension (or pile diameter).

4.7 Foundations

Following bulk excavation to RL 2.7m, we expect Unit 5 sandstone to be exposed at BEL.

It is recommended that all footings for the building be founded within the sandstone bedrock of similar strength to provide uniform support and reduce the potential for differential settlements.

Pad or strip footings founded within Unit 5 may be preliminarily designed for an allowable bearing capacity of 3500kPa, based on serviceability.

Geotechnical inspections of foundations are recommended to determine that the required bearing capacity has been achieved and to determine any variations that may occur between the boreholes and inspected locations.

Footings founded at or near a crest of an excavation (such as the building located to the north) should be founded below the zone of influence of the lower basement retaining walls, which may be taken as founding below a line drawn at 1 Vertical to 1 Horizontal from the base of the retaining walls. Piles may be required. Specific geotechnical advice should be obtained for such footings taken into consideration the basement excavation and the quality of sandstone at the particular footing location.

4.8 Basement Floor Slab

Following bulk excavations for the proposed basement, sandstone bedrock is expected to be exposed at the basement floor BEL.

Following the removal of all loose and softened materials, we recommend that underfloor drainage be provided and should comprise a strong, durable, single sized washed aggregate such as ‘blue metal gravel’. Joints in the concrete floor slab should be designed to accommodate shear forces but not bending moments by using dowelled and keyed joints. The basement floor slab should be isolated from columns. The completed excavation should be inspected by the hydraulic engineer to confirm the extent of the drainage required.

In addition, a system of sub-soil drains comprising a durable single sized aggregate with perforated drains/pipes leading to sumps should be provided. The basement floor slab should be isolated from columns.

Permission may need to be obtained from the NSW Department of Primary Industries (DPI) and possibly Council for any permanent discharge of seepage into the drainage system. Given the subsurface conditions, we expect that seepage volumes would be low and within the DPI limits. However, if permission for discharge is not obtained, the basement may need to be designed as a tanked basement.

5. Further Geotechnical Inputs

Below is a summary of the previously recommended additional work that needs to be carried out:

- Additional Geotechnical Investigation in the form of at least four cored boreholes to provide detailed information on the rock parameters for the cost effective design of foundations, shoring and excavation. The boreholes should extend a minimum of 4m below the bulk excavation level, depending on proposed loading based on structural drawings.
- An inclined borehole may be appropriate to investigate the possibility of any dykes within the site.
- Installation of at least two additional monitoring wells;
- Long term groundwater monitoring and seepage modelling;
- Numerical analysis for assessing the impacts on the RMS asset;
- Dilapidation surveys;
- Design of working platforms (if required) for construction plant by an experienced and qualified geotechnical engineer;
- Classification of all excavated material transported off site;
- Witnessing installation of support measures and proof-testing of anchors (if required).
- Geotechnical inspections of all new footings/piles by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata; and
- Ongoing monitoring of groundwater inflows into the bulk excavation;

We recommend that a meeting be held after initial structural design has been completed to confirm that our recommendations have been correctly interpreted. We also recommend a meeting at the commencement of construction to discuss the primary geotechnical issues and inspection requirements.

6. Statement of Limitations

This report has been prepared for the exclusive use of Mitchell Favaloro and Samprian Pty Ltd who is the only intended beneficiary of EI's work. The scope of the assessment carried out for the purpose of this report is limited to those agreed with Mitchell Favaloro and Samprian Pty Ltd.

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the geotechnical industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling and test locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also hafve relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during construction. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

We draw your attention to the document "Important Information", which is included in **Appendix D** 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.

References

AS1289.6.3.1:2004, *Methods of Testing Soils for Engineering Purposes,* Standards Australia.

AS1726:2017, *Geotechnical Site Investigations*, Standards Australia.

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

AS3600:2009, *Concrete Structures,* Standards Australia

Safe Work Australia Excavation Work Code of Practice, dated August 2019 – WorkCover NSW

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

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

Abbreviations

AHD	Australian Height Datum
AS	Australian Standard
BEL	Bulk Excavation Level
BEGL	Below Existing Ground Level
BH	Borehole
DBYD	Dial Before You Dig
DP	Deposited Plan
EI	EI Australia
GI	Geotechnical Investigation
NATA	National Association of Testing Authorities, Australia
RL	Reduced Level
SPT	Standard Penetration Test
T-C	Tungsten-Carbide
UCS	Unconfined Compressive Strength

Figures

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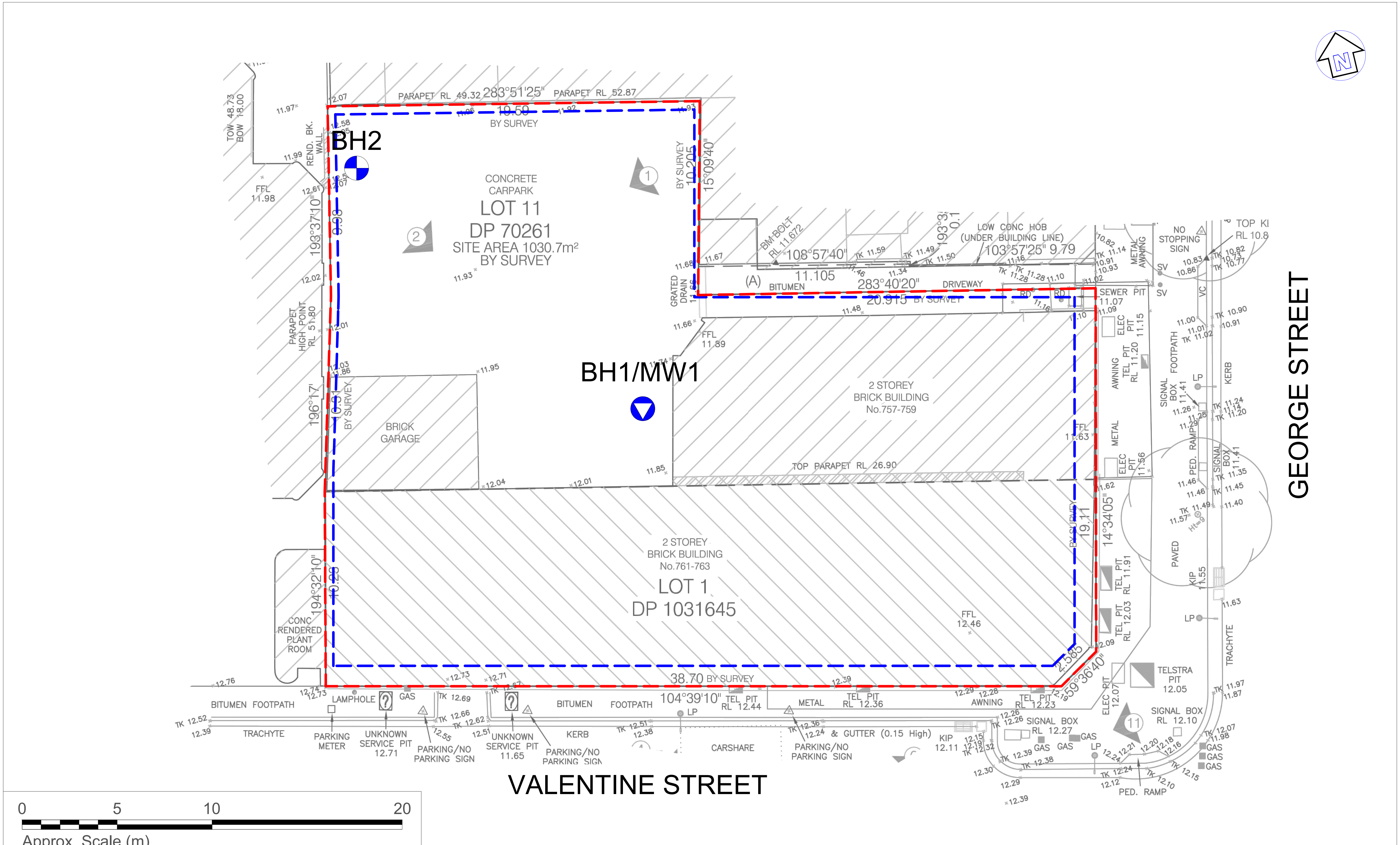
Drawn:	J.W.
Approved:	-
Date:	-
Scale:	Not To Scale

Sampian Pty Ltd
Preliminary Geotechnical Investigation
757-763 George Street, Haymarket NSW
Site Locality Plan

Figure:
1

Project: E22293 GA_Rev3



Map Source: Detailed site survey plan prepared by Lawrence Group Pty Ltd - Job No. 142937, Drawing No. DETL-001/A, Sheet 1 of 3, dated 21 August 2014

LEGEND

- – – – Approximate site boundary
- – – – Approximate basement boundary
- ◐ Approximate borehole location
- ▼ Approximate monitoring well/borehole location

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Date:	-

Samprian Pty Ltd
Preliminary Geotechnical Investigation
757-763 George Street, Haymarket NSW
Borehole Location Plan

Figure:
2

Project: E22293 GA_Rev3

Appendix A – Borehole Logs And Explanatory Notes

BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Sheet	1 OF 3
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

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
DT	-		0	0.10				-	FILL: CONCRETE; 100 mm.	-		CONCRETE HARDSTAND
AD/T	VH	GWNE		0.80	BH1-1 ES 0.10-0.20 m SPT 0.50-0.95 m 20,8,4 N=12 BH1-2			-	FILL: Silty SAND; fine to medium grained, brown-red, trace brick gravel; medium to coarse, angular.	W	-	FILL
	H		1	1.50	BH1-3 ES 1.00-1.20 m			CH	CLAY; high plasticity, brownish yellow with red mottling, trace fine to medium grained sand.	M - D	St	RESIDUAL SOIL
			2	3.00	SPT 1.50-1.95 m 3,4,7 N=11 BH1-4			CI	Silty CLAY; medium plasticity, pale grey mottled red, trace rootlets.			
			3	3.80	SPT 3.00-3.45 m 6,14,17 N=31 BH1-5			-	SANDSTONE; pale grey with orange iron staining, inferred extremely low strength, inferred extremely weathered.	-	-	WEATHERED ROCK
			4 5	6.00	SPT 4.50-4.95 m 9,9,14 N=23 BH1-6				From 3.8 m, as above, pale brown with orange-red ironstaining.			
	VH		6 7	7.30	SPT 6.00-6.25 m 16,30 N=30/100mm BH1-7			-	SANDSTONE; fine to medium grained, grey with orange ironstaining, inferred very low strength, inferred distinctly weathered.			
			8 9 10						Continued as Cored Borehole			

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

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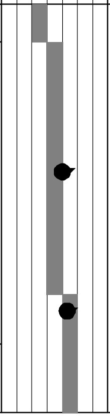
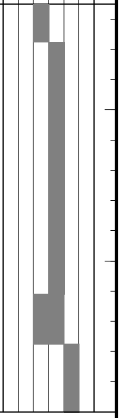
BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Sheet	2 OF 3
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

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	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
				0 – 7	*7.30*		Continuation from non-cored borehole				
NMLC	60-70% RETURN	100	78 (83)		*7.95*		SANDSTONE; fine to medium grained, bedding dipping 0-5 degrees, <1 mm thick, average spacing = <1-5 mm, grey-pale brown.	DW SW		7.36-7.55: BPx3 0 - 5° PR RF Fe SN 7.59: BP 5° PR RF CN 7.89: BP 10° PR RF CN	
				8 – 9	*9.22*		SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 1-10 mm, grey-dark grey.			8.62: JT 10° PR RF CN 8.62-8.73: JT 70 - 80° UN RF CN 8.73: BP 20° PR RF CN 8.90: JT 60° PR RF CN 9.00-9.20: JT 70° PR RF CN	
					9.55		SANDSTONE; fine to medium grained, bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-5 mm.			9.21: BP 10° PR RF CN 9.33: BP 0° PR RF CN 9.49-9.55: BPx3 0 - 10° PR RF CN avg sp = 20-50 mm	
				10			SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 10-30 mm, grey-dark grey.	FR			





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

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BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Sheet	3 OF 3
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	DEFECT DESCRIPTION & Additional Observations
NMLC	60-70% RETURN	100		10	10.05		FR		9.94-10.04: HB
		100	95 (87)		10.61	SANDSTONE; medium grained, bedding dipping 20-30 degrees, 2-3 mm thick, average spacing = 3-10 mm, grey-dark grey.			10.40-10.42: BPx2 30° PR RF CN
				11	11.00	SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.			10.62: BP 0° PR RF CN
					12.00	From 11 m, as above, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 5-10 mm, grey-dark grey.		●	11.15-11.84: BPx3 10 - 30° PR RF CN avg sp = 100-500 mm
				12	12.60	SANDSTONE; coarse grained, bedding dipping 0-10 degrees, 2-3 mm thick, average spacing = 1-5 mm, dark grey-grey.			12.04: BP 10° healed 12.06-12.12: BPx2 0° PR RF VNR Sandy CLAY; soft, sand is fine to medium grained 12.22-12.70: BPx3 0 - 10° PR RF CN avg sp = 200-300 mm
				13	13.42	SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.		●	
		100	96 (89)		14.00	From 13.42 m, as above, bedding is 1-3 mm thick.			13.71-13.90: BPx2 10 - 20° PR RF CN
				14	14.95	SANDSTONE; coarse grained, bedding dipping 20-30 degrees, 1-3 mm thick, average spacing = 10-30 mm, grey-dark grey.			14.07-14.51: DB 14.74: BP10 PR RF CN
				15		Hole Terminated at 14.95 m Target depth reached. Monitoring well installed. Backfilled with bentonite and sand. Capped with concrete and gatic cover			
				16					
				17					
				18					
				19					
				20					

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

REPORT OF BOREHOLE: BH1/MW1

CLIENT: Samprian Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 757-763 George St, Haymarket NSW
JOB NO: E22293

EAST: 333917.396 m
NORTH: 6249510.394 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 2
HOLE DEPTH: 14.95 m

DEPTH RANGE: 7.30 m to 14.95 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014
CHECKED: RP DATE: 03/10/2014

REPORT OF BOREHOLE: BH1/MW1

CLIENT: Samprian Pty Ltd
PROJECT: Preliminary Geotechnical Investigation

LOCATION: 757-763 George St, Haymarket NSW

JOB NO: E22293

EAST: 333917.396 m
NORTH: 6249510.394 m MGA94 Zone 56

INCLINATION: -90°
BOX: 2 of 2
HOLE DEPTH: 14.95 m

DEPTH RANGE: 7.30 m to 14.95 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014

CHECKED: RP DATE: 03/10/2014

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BOREHOLE: BH2

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Sheet	1 OF 3
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

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
DT	-	GWNE	0	0.10				-	FILL: CONCRETE; 100 mm.	-	-	CONCRETE HARDSTAND
AD/T	E-F				BH2-1 ES 0.11-0.21 m			-	VOID: 10 mm.	W		FILL
								-	FILL: SAND; fine to coarse grained, poorly graded, pale brown.			
				0.50	SPT 0.50-0.95 m 1,1,1 N=2 BH2-2			-	FILL: Clayey SAND; fine to medium grained, brown-orange, trace brick and concrete gravel; coarse, subrounded.	M - D		
			1									
				1.50	SPT 1.50-1.95 m 1,2,3 N=5 BH2-3			-	FILL: Sandy CLAY; low plasticity, brown-orange, sand is fine to medium grained, trace brick and concrete gravel; fine to medium, angular.			
			2									
			3		SPT 3.00-3.45 m 1 BH2-4							
			4									
				4.50	SPT 4.50-4.95 m 2,1,1 N=2 BH2-5			-	From 4.5 m, as above, brown with red mottling, trace brick and concrete gravel; medium to coarse, subangular to subrounded.			
			5									
	VH		6	6.00	SPT 6.00-6.02 m 8/20mm HB BH2-6				From 6.0-6.24 m, inferred dense brick layer.			
	H											
			7	7.25								
									Continued as Cored Borehole			
			8									
			9									
			10									

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

BOREHOLE: BH2

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Sheet	2 OF 3
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

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	DEFECT DESCRIPTION & Additional Observations
				0–7	*7.25*		Continuation from non-cored borehole			
NMLC	70-80% RETURN	100	64 (89)	8			SANDSTONE; fine grained, bedding dipping 0-5 degrees, dark grey with black organic matter through bedding.	DW		7.30-8.35: BPx22 0 - 5° PR RF Fe SN avg sp = 5-30 mm 7.97-7.98: CS 10 mm, GRAVEL; coarse, subrounded 8.01-8.05: DS 40 mm, SAND; fine to medium grained 8.20-8.26: DZ 60 mm, SAND; fine to medium grained
				9	*8.35*		SANDSTONE; medium to coarse grained, bedding dipping 10-30 degrees, 1-3 mm thick, average spacing = 3-10 mm, grey-dark grey.	SW		8.62: BP 5° PR RF CN 9.07: BP 5° PR RF CN 9.26: BP 5° PR RF CN 9.35: JT 0 - 20° CU RF CN
					9.42		SANDSTONE; fine to medium grained, bedding dipping 10-20 degrees, 1-3 mm thick, average spacing = <1-5 mm, dark grey-grey.			9.51-9.73: BPx3 0 - 5° PR RF CN avg sp = 5-20 mm
				10	*9.74*			FR		

INFERRED STRENGTH: EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH

AVERAGE DEFECT SPACING (mm): 10 30 100 300 1000 3000

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

BOREHOLE: BH2

Project	Haymarket Geotechnical investigation				
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Sheet	3 OF 3
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Started	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Date Completed	18/8/14
Client	Samprian Pty Ltd	Drill Rig	MD 3000	Logged SK	Date: 18/8/14
		Inclination	-90°	Checked RP	Date: 3/10/14

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)
NMLC	70-80% RETURN	100	64 (89)	10			SANDSTONE; coarse grained, bedding dipping 20-30 degrees, 1-3 mm thick, average spacing = 10-30 mm, pale grey-grey.	FR			
										10.60: JT 0° PR RF CN	
		100	93 (96)	11	10.90		From 10.9 m, average spacing = 3-10 mm.				
										11.14: JT 0° PR RF CN	
									●	11.33-11.82: BPx3 20 - 30° PR RF CN avg sp = 200-300 mm	
				12	12.00					11.95: JT 0° PR RF CN	
							Hole Terminated at 12.00 m Target depth reached. Backfilled to surface level with drilling spoil and concrete capped.				
				13							
				14							
				15							
				16							
				17							
				18							
				19							
				20							

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

REPORT OF BOREHOLE: BH2

CLIENT: Samprian Pty Ltd
PROJECT: Preliminary Geotechnical Investigation
LOCATION: 757-763 George St, Haymarket NSW
JOB NO: E22293

EAST: 333905.891 m
NORTH: 6249525.260 m MGA94 Zone 56
INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 12.00 m

DEPTH RANGE: 7.25 m to 12.00 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014
CHECKED: RP DATE: 03/10/2014

DATE: 18/8/14
BOREHOLE ID: BH2
DEPTH FROM: 7.25 m
DEPTH TO: 12.00m
BOX: 1 OF 1

PROJECT NUMBER: E22293
SITE: 757-751 GEORGE STREET, HAYMARKET.
CLIENT: CEEROSE PTY LTD
LOGGED BY: SK

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

DRILLING/EXCAVATION METHOD

HA	Hand Auger	**ADH**	Hollow Auger	**NQ**	Diamond Core - 47 mm
DT	Diatube Coring	**RT**	Rotary Tricone bit	**NMLC**	Diamond Core - 52 mm
NDD	Non-destructive digging	**RAB**	Rotary Air Blast	**HQ**	Diamond Core - 63 mm
AD*	Auger Drilling	**RC**	Reverse Circulation	**HMLC**	Diamond Core - 63 mm
***V**	V-Bit	**PT**	Push Tube	**EX**	Tracked Hydraulic Excavator
***T**	TC-Bit, e.g. AD/T	**WB**	Washbore	**HAND**	Excavated by Hand Methods

PENETRATION 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

▽ **Standing Water Level** ◁ **Partial water loss**

▷ **Water Seepage** ◀ **Complete Water Loss**

GWNO	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.
GWNE	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 a 150mm seating drive
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported, N is not reported
RW	Penetration occurred under the rod weight only, N<1
HW	Penetration occurred under the hammer and rod weight only, N<1
HB	Hammer double bouncing on anvil, N is not reported
Sampling	
DS	Disturbed Sample
ES	Sample for environmental testing
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U50	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

GEOLOGICAL BOUNDARIES

——————— = Observed Boundary (position known)

– – – – – – – – – – – = Observed Boundary (position approximate)

– –?– –?– –?– – = Boundary (interpreted or inferred)

ROCK CORE RECOVERY

TCR=Total Core Recovery (%)

$$= \frac{\boldsymbol{Length\ of\ core\ recovered}}{\boldsymbol{Length\ of\ core\ run}} \times \mathbf{100}$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \boldsymbol{Axial\ lengths\ of\ core} > \mathbf{100}\boldsymbol{mm}}{\boldsymbol{Length\ of\ core\ run}} \times \mathbf{100}$$

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			

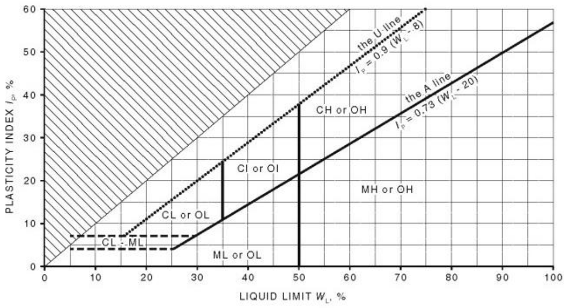
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS 1726:2017, Section 6.1 – Soil description and classification.

PARTICLE SIZE CHARACTERISTICS

Fraction	Components	Sub Division	Size mm
Oversize	BOULDERS		>200
	COBBLES		63 to 200
Coarse grained soil	GRAVEL	Coarse	19 to 63
		Medium	6.7 to 19
		Fine	2.36 to 6.7
	SAND	Coarse	0.6 to 2.36
		Medium	0.21 to 0.6
		Fine	0.075 to 0.21
Fine grained soil	SILT		0.002 to 0.075
	CLAY		<0.002

PLASTICITY PROPERTIES



GROUP SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 65% of soil excluding oversize fraction is greater than 0.075mm	**GRAVEL** More than 50% of coarse fraction is >2.36mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines, no dry strength.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines, no dry strength.
		GM	Silty gravel, gravel-sand-silt mixtures, zero to medium dry strength.
		GC	Clayey gravel, gravel-sand-clay mixtures, medium to high dry strength.
	SAND More than 50% of coarse fraction is <2.36 mm	SW	Well graded sand and gravelly sand, little or no fines, no dry strength.
		SP	Poorly graded sand and gravelly sand, little or no fines, no dry strength.
		SM	Silty sand, sand-silt mixtures, zero to medium dry strength.
		SC	Clayey sand, sandy-clay mixtures, medium to high dry strength.
FINE GRAINED SOILS More than 35% of soil excluding oversized fraction 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, zero to medium dry strength.
		CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, medium to high dry strength.
		OL	Organic silts and organic silty clays of low plasticity, low to medium dry strength.
	Liquid Limit > than 50%	MH	Inorganic silts of high plasticity, high to very high dry strength.
		CH	Inorganic clays of high plasticity, high to very high dry strength.
		OH	Organic clays of medium to high plasticity, medium to high dry strength.
Highly Organic soil		PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Non- cohesive and free-running.
M	Moist	Soils feel cool, darkened in colour. Soil tends to stick together.
W	Wet	Soils feel cool, darkened in colour. Soil tends to stick together, free water forms when handling.

Moisture content of cohesive soils shall be described in relation to plastic limit (PL) or liquid limit (LL) for soils with higher moisture content as follows: Moist, dry of plastic limit (w < PL); Moist, near plastic limit (w ≈ PL); Moist, wet of plastic limit (w < PL); Wet, near liquid limit (w ≈ LL), Wet, wet of liquid limit (w > LL),

CONSISTENCY

Symbol	Term	Undrained Shear Strength (kPa)	SPT "N" #
VS	Very Soft	≤ 12	≤ 2
S	Soft	>12 to ≤ 25	>2 to ≤ 4
F	Firm	>25 to ≤ 50	>4 to 8
St	Stiff	>50 to ≤ 100	>8 to 15
VSt	Very Stiff	>100 to ≤ 200	>15 to 30
H	Hard	>200	>30
Fr	Friable	-	

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	≤ 15	0 to 4
L	Loose	>15 to ≤ 35	4 to 10
MD	Medium Dense	>35 to ≤ 65	10 to 30
D	Dense	>65 to ≤ 85	30 to 50
VD	Very Dense	>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 AS1726:2017, and may be subject to corrections for overburden pressure, moisture content of the soil, and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Add '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%
Add 'With'	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%
Prefix soil name	Presence easily detectable by feel or eye in conjunction with the general properties of primary component	Coarse grained soils: >12% Fine grained soil: >30%

TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

ROCK MATERIAL STRENGTH CLASSIFICATION

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa) #	Field Guide
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. However UCS is typically 20 x $Is_{(50)}$.

ROCK MATERIAL WEATHERING CLASSIFICATION

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.
XW		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.

ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

DETAILED ROCK DEFECT SPACING

Defect Spacing

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

Bedding Thickness (Stratification)

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.
Contact	CO	The surface between two types or ages of rock.
Sheared Surface	SSU	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.
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.
Extremely Weathered Seam/ Zone	XWS/XWZ	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.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

NOTE: Defects size of <100mm SS, CS and XWS. Defects size of >100mm SZ, CZ and XWZ.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	PR	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	SM	Smooth to touch. Few or no surface irregularities
Stepped	ST	One or more well defined steps	Rough	RO	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	OP	Without any infill material.
Infilled	-	Soil or rock i.e. clay, silt, talc, pyrite, quartz, etc.

Appendix B - Laboratory Certificates

Resource Laboratories

ABN: 25 131 532 020
Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145
Ph: (02) 9674 7711 **| Fax:** (02) 9674 7755 **| Email:** info@resourcelab.com.au

Test Report

Customer: Environmental Investigations Australia Pty Ltd
Project: PGI - E22293
Location: 757-761 George Street, Haymarket NSW

Job number: 14-0075
Report number: 1
Page: 1 of 1

Moisture Content

Sampling method: Sample tested as received

Test method(s): AS 1289.1.1, 2.1.1

	Results				
Laboratory sample no.	4819				
Customer sample no.	BH1 - 4 1.5-1.95m				
Date sampled	18/08/2014				
Material description	SILTY CLAY, pale grey mottled orange/red				
Moisture content (%)	17.1				

Laboratory sample no.					
Customer sample no.					
Date sampled					
Material description					
Moisture content (%)					

Approved Signatory: E. Maldonado **Date:** 26/08/2014

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

Resource Laboratories

ABN: 25 131 532 020

Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145
Ph: (02) 9674 7711 **| Fax:** (02) 9674 7755 **| Email:** info@resourcelab.com.au

Test Report

Customer: Environmental Investigations Australia Pty Ltd
Job number: 14-0075
Project: PGI - E22293
Report number: 2
Location: 757-761 George Street, Haymarket NSW
Page: 1 of 1

Soil Index Properties

Sampling method: Sample tested as received

Test method(s): AS 1289.1.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1

	Results				
Laboratory sample no.	4819				
Customer sample no.	BH1 - 4 1.5-1.95m				
Date sampled	18/08/2014				
Material description	SILTY CLAY, pale grey mottled orange/red				
Liquid limit (%)	47				
Plastic limit (%)	15				
Plasticity index (%)	32				
Linear shrinkage (%)	-				
Cracking / Curling / Crumbling	-				
Sample history	Oven dried				
Preparation	Dry sieved				

Notes:

Approved Signatory: E. Maldonado

Date: 27/08/2014

ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

Resource Laboratories

ABN: 25 131 532 020
Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145
Ph: (02) 9674 7711 | **Fax**: (02) 9674 7755 | **Email**: info@resourcelab.com.au

Test Report

Customer: Environmental Investigations Australia Pty Ltd
Job number: 14-0075
Project: PGI - E22293
Report number: 3
Location: 757-761 George Street, Haymarket NSW
Page: 1 of 2

Point Load Strength Index

Sampling method: Samples tested as received
Test method(s): AS 4133.4.1 Clause 3.2, 3.3

	Results				
Laboratory sample no.	4821	4822	4823	4824	
Customer sample no.	BH1	BH1	BH1	BH1	
Sample depth	8.41-8.62m	9.33-9.50m	11.65-11.84m	13.00-13.31m	
Date sampled	18/08/2014	18/08/2014	18/08/2014	18/08/2014	
Date tested	22/08/2014	22/08/2014	22/08/2014	22/08/2014	
Lithological description	SANDSTONE	SANDSTONE	SANDSTONE	SANDSTONE	
Diametral					
Moisture content condition	Moist	Moist	Moist	Moist	
Nature of weakness planes	Laminated	Laminated	Laminated	Bedded	
Specimen size Length (mm)	37.0	42.5	38.0	42.0	
Diameter (mm)	51.5	51.5	51.5	51.5	
I_s (MPa)	**0.95**	**1.4**	**1.8**	**1.3**	
$I_{s(50)}$ (MPa)	**0.97**	**1.4**	**1.8**	**1.3**	
Failure mode	Paralell to laminae	Paralell to laminae	Paralell to laminae	Paralell to bedding	
Axial					
Moisture content condition	Moist	Moist	Moist	Moist	
Nature of weakness planes	Laminated	Laminated	Laminated	Bedded	
Specimen size Height (mm)	38.5	42.0	37.5	39.5	
Diameter (mm)	51.5	51.5	51.5	51.5	
I_s (MPa)	**1.4**	**1.6**	**1.7**	**1.6**	
$I_{s(50)}$ (MPa)	**1.4**	**1.7**	**1.7**	**1.6**	
Failure mode	Perpendicular to laminae	Perpendicular to laminae	Perpendicular to laminae	Perpendicular to bedding	

Notes:

Approved Signatory: E. Maldonado
Date: 27/08/2014

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

Resource Laboratories

ABN: 25 131 532 020

Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145

Ph: (02) 9674 7711 | **Fax**: (02) 9674 7755 | **Email**: info@resourcelab.com.au

Test Report

Customer: Environmental Investigations Australia Pty Ltd **Job number:** 14-0075

Project: PGI - E22293 **Report number:** 3

Location: 757-761 George Street, Haymarket NSW **Page:** 2 of 2

Point Load Strength Index

Sampling method: Samples tested as received **Test method(s):** AS 4133.4.1 Clause 3.2, 3.3

	Results				
Laboratory sample no.	4825	4826	4827	4828	
Customer sample no.	BH2	BH2	BH2	BH2	
Sample depth	7.71-7.78m	9.35-9.51m	9.74-10.00m	11.35-11.51m	
Date sampled	18/08/2014	18/08/2014	18/08/2014	18/08/2014	
Date tested	22/08/2014	22/08/2014	22/08/2014	22/08/2014	
Lithological description	SANDSTONE	SANDSTONE	SANDSTONE	SANDSTONE	
Diametral					
Moisture content condition	Moist	Moist	Moist	Moist	
Nature of weakness planes	Bedded	Bedded	Bedded	Laminated	
Specimen size Length (mm)	35.0	35.0	44.0	38.0	
Diameter (mm)	51.5	51.5	51.5	51.5	
I_s (MPa)	**0.23**	**1.3**	**1.4**	**1.6**	
$I_{s(50)}$ (MPa)	**0.23**	**1.3**	**1.4**	**1.6**	
Failure mode	Paralell to bedding	Paralell to bedding	Paralell to bedding	Paralell to laminae	
Axial					
Moisture content condition	Moist	Moist	Moist	Moist	
Nature of weakness planes	Bedded	Bedded	Bedded	Laminated	
Specimen size Height (mm)	34.0	34.5	43.5	35.5	
Diameter (mm)	51.5	51.5	51.5	51.5	
I_s (MPa)	**0.50**	**1.4**	**1.2**	**1.7**	
$I_{s(50)}$ (MPa)	**0.49**	**1.4**	**1.3**	**1.7**	
Failure mode	Perpendicular to bedding	Perpendicular to bedding	Perpendicular to bedding	Perpendicular to laminae	

Notes:

Approved Signatory: E. Maldonado **Date:** 27/08/2014

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

Resource Laboratories

ABN: 25 131 532 020

Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145
Ph: (02) 9674 7711 **| Fax:** (02) 9674 7755 **| Email:** info@resourcelab.com.au

Test Report

Customer: Environmental Investigations Australia Pty Ltd
Job number: 14-0075
Project: PGI - E22293
Report number: 4
Location: 757-761 George Street, Haymarket NSW
Page: 1 of 1

Soil Aggressivity

Sampling method: Samples tested as received

Test method(s): AS 1289.1.1, EA002, EA010
ED040, ED045G.

	Results				
Laboratory sample no.	4819	4820			
Customer sample no.	BH1 - 4 1.5-1.95m	BH1 - 6 4.5-4.95m			
Date sampled	18/08/2014	18/08/2014			
Material description	SILTY CLAY, pale grey mottled orange/red	CLAY, mottled grey/red-brown/ orange-brown			
pH	5.5	5.2			
Electrical conductivity (µS/cm)	46	78			
Sulfate SO_4 (mg/kg)	160	650			
Chloride Cl (mg/kg)	10	30			

Notes: EA002: pH (Soils), EA010: Conductivity, ED040: Sulfur as SO4 2-, ED045G: Chloride Discrete Analyser - tested by Australian Laboratory Services, NATA accredited laboratory number 825. Report reference ES1418447.

Approved By: . E. Maldonado

Date: 27/08/2014

Appendix C – Vibration Limits

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally considered to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) directions, in the plane of the uppermost floor), are summarised in **Table A** below.

It should be noted that peak vibration velocities higher than the minimum figures in **Table A** for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual conditions of the structures.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table A DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity (mm/s)			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note: For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

Appendix D – Important Information

Important Information

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 EI Australia ("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

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. 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.