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SIRIUS DEVELOPMENTS PTY LTD

Geotechnical Investigation

2-60 Cumberland Street, The Rocks

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6 July 2020

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Revision	Details	Date	Amended By
	Original	26 June 2020	
Rev1	Updated Drawings	3 July 2020	IW
Rev2	Survey Plan	6 July 2020	SK

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1. Introduction

1.1 Background

At the request of Sirius Developments Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Investigation (GI) for the proposed development at 2-60 Cumberland Street, The Rocks (the Site).

This GI report has been prepared to provide advice and recommendations to assist in the preparation of designs for the proposed development. The investigation has been carried out in accordance with the agreed scope of works outlined in EI's proposal referenced P17797.6, dated 5 March 2020, and with the Client's signed authorisation to proceed, dated 10 March 2020.

1.2 Proposed Development

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

- Geotechnical Brief, prepared by SCP Engineers and development consults, dated 12 December 2019;
- Architectural drawings, prepared by BVN Architecture Pty Ltd, Project No. 1712011, Drawings;
  - AR-B-10-01, Issue 17, dated 23 June 2020;
  - AR-B-10-02, Issue 14, dated 23 June 2020; and
  - AR-D-10-01, Issue 1, dated 26 June 2020.
- Preliminary Site Investigation, prepared by EP Risk Management Pty Ltd, Project No. EP0643.001, dated 28 September 2017;
- Architectural and structural plans, prepared by the Housing Commission of NSW, Job No. 3/7799/1/1, dated circa 1977. Note that these plans are not as-built plans and their accuracy is not confirmed by Property NSW; and
- Survey plan, prepared by LTS Lockley, Reference 50025 DT 004, Sheet 1 to 9 of 9, Revision D, dated 7 April 2020.

Based on the above mentioned plans, EI understands that the proposed development involves the refurbishment of the existing structure, including the excavation of an additional basement level in the southern portion of the site. The lowest basement level is proposed to have a finished floor level (FFL) of between RL 18.0m and 18.72m. Bulk Excavation Levels (BEL's) ranging between RL 17.80m and RL 18.50m are assumed, which include allowance for the construction of the basement slab. To achieve the BEL, excavation depths up to 6.80m Below Existing Ground Level (BEGL) have been estimated. Locally deeper excavations may be required for footings, lift overrun pits, crane pads, and service trenches.

1.3 Objectives

The objective of the GI was to investigate the existing site subsurface conditions at 11 borehole locations. It is understood that as part of the proposed modification to the structure, the existing footings may be required to support the additional loads that originally designed for. To investigate the founding conditions beneath the existing footings, 9 boreholes were drilled through the existing footings and 2 boreholes were drilled adjacent to the existing retaining

walls in order to provide preliminary geotechnical advice and recommendations addressing the following:

- Excavation methodologies and monitoring requirements;
- Groundwater considerations;
- Vibration considerations;
- Excavation support requirements, including preliminary geotechnical design parameters for retaining walls and shoring systems;
- Building foundation options, including;
  - Preliminary design parameters for material beneath the footings.
  - Earthquake loading factor in accordance with AS1170.4:2007.
- The requirement for additional geotechnical works.

1.4 Scope of Works

The scope of works for the GI 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;
- Drilling of eleven boreholes (BH1 to BH11M) using NMLC and Diatube diamond coring techniques to termination depths of between 3.69m to 8.47m BEGL (RL18.91m to RL 14.86m). The rock core photographs are presented in **Appendix A**;
  - The approximate surface levels shown on the borehole logs were interpolated from spot levels shown on the supplied architectural plans. Approximate borehole locations are shown on **Figure 2**;
- Borehole BH6M, BH8M and BH 11M were converted into groundwater monitoring wells with a depth of 5.02m BEGL (RL17.68m), 5.62m BEGL (RL17.98m) and 8.00m BEGL (RL16.80m) to allow for long-term groundwater monitoring;
- The remaining boreholes were filled with grout and capped with concrete upon completion;
- Soil and rock samples were sent to Macquarie Geotechnical Pty Ltd (Macquarie) and SGS Australia (SGS), which are National Australian Testing Authority (NATA) accredited laboratories, for testing and storage; and
- Preparation of this GI 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 GI was limited by the intent of the investigation and the presence of existing site structures. The discussions and advice presented in this report are preliminary and intended to assist in the preparation of initial designs for the proposed development. Further geotechnical inspections should be carried out during construction to confirm the geotechnical and groundwater models, 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	2-60 Cumberland Street, The Rocks
Lot and Deposited Plan (DP) Identification	Lots 100 and 101 in DP 264104
Brief Site Description	At the time of our investigation, the site was occupied by a concrete apartment building, the Sirius Building, with a single level basement carpark extending below the majority of the site.
Site Area	The site area is approximately 3,664m^2 (as per survey).

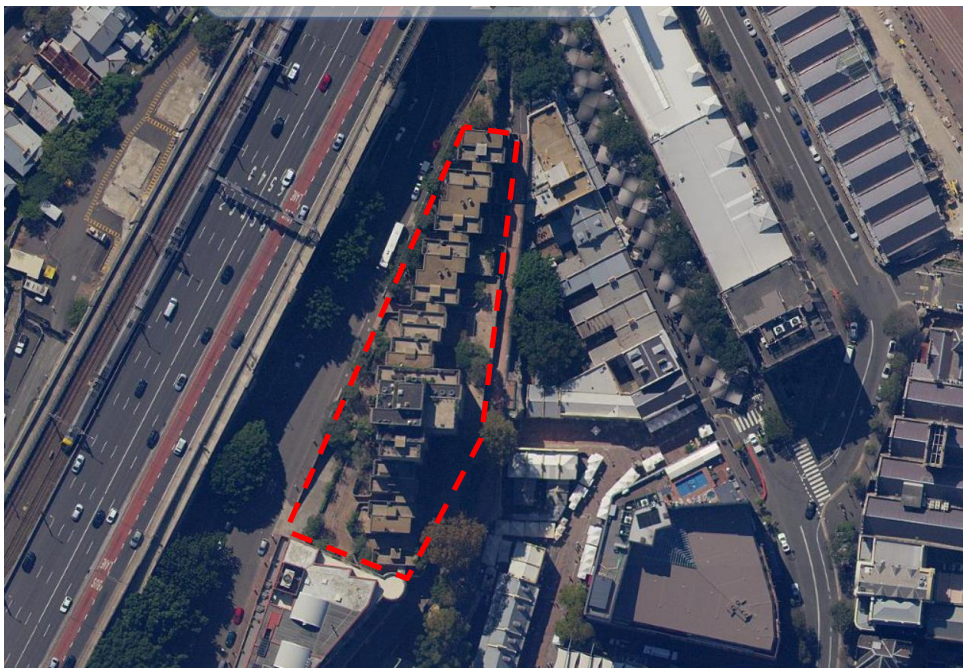


Plate 1: Aerial photograph of the site (source: Six Maps, accessed 16/6/20)

2.2 Local Land Use

The site is situated within an area of commercial and residential use. Current uses on surrounding land at the time of our presence on site are described in **Table 2-2** below. For the sake of this report, the site boundary adjacent to Cumberland Street shall be adopted as the western site boundary.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	Property at No. 23 Gloucester Walk, consisting of a two storey, brick and concrete building, with at least one basement level observed. The structure is built into the existing slope underneath Cumberland Street above. No. 23 Gloucester Walk is on a similar elevation to the northern site boundary.
East	Gloucester Walk, a public pedestrian walkway, followed by a sandstone block retaining wall located above a vertical cut face, of approximately 10m to 15m height. The bedrock exposed over the cut face is characterised as slightly weathered, massive sandstone of at least medium strength containing sub-horizontal bedding defects. The retaining wall and vertical cut was followed by properties No. 25 to 41 George Street, No. 3 and 4 Atherden Street and No. 5, 13 and 19A Playfair Street, consisting of one to three storey brick terrace buildings.
South	Property at No. 86 Cumberland Street, consisting of a 4 storey brick and concrete building, that appeared to be on similar level to the site, with a basement carpark observed.
West	Cumberland Street, a two lane asphalt paved road with on street parking, followed by the Bradfield Hwy, consisting of a raised eight lane highway leading to the Sydney Harbour Bridge.

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 site is located on the eastern side of Cumberland Street within moderately (10° to 18°) east dipping topography.
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 1983) indicates the site to be underlain by Hawkesbury Sandstone, which consists of medium to coarse-grained quartz sandstone with very minor shale and laminite lenses.

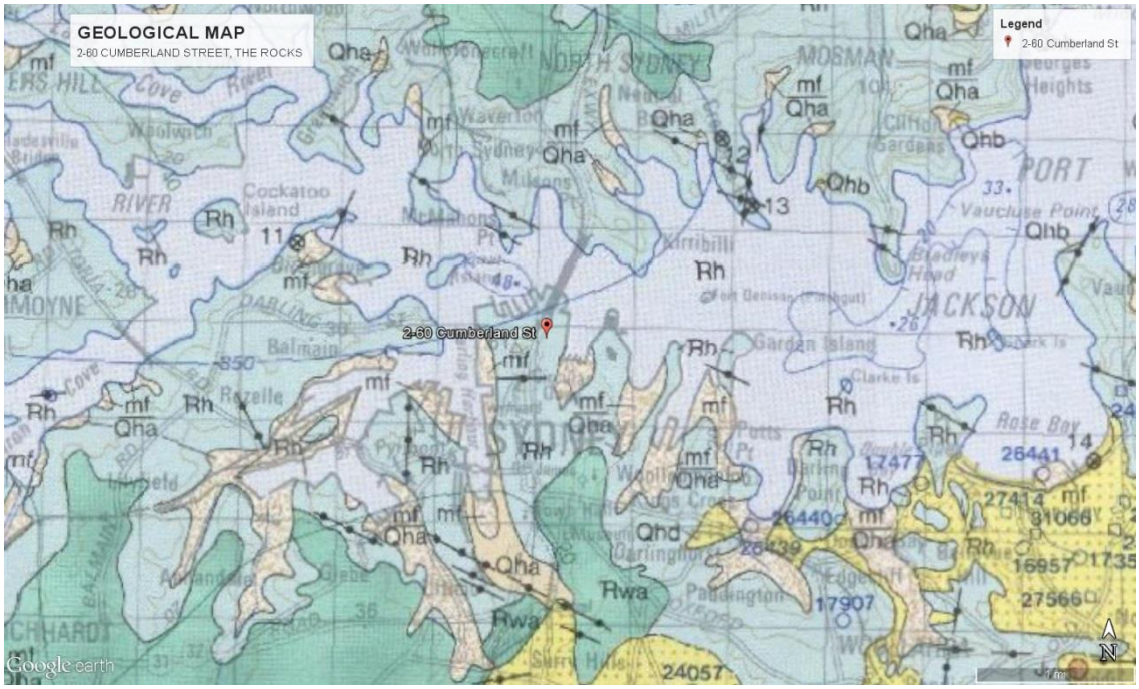


Plate 2: Excerpt of geological map showing location of site.

3. Investigation Results

3.1 Stratigraphy

For the development of a site-specific geotechnical model, the stratigraphy observed in the GI has been grouped into two geotechnical units. A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 3-1** below. More detailed descriptions of subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**. The details of the methods of soil and rock classifications, explanatory notes and abbreviations adopted on the borehole logs are also presented in **Appendix A.**

Table 3-1 Summary of Subsurface Conditions

Unit	Material2	Depth to Top of Unit (m BEGL)1	RL of Top of Unit (m AHD)1	Observed Thickness (m)	Comments
1	**Concrete Slab, Fill and Concrete footings**	Surface	19.10 to 24.80	0.26 to 3.08	Concrete pavements of between 90mm and 190mm thickness, underlain by sandy Gravel and Gravel fill, generally underlain by Concrete footings of between 350mm and 1130mm thickness.
2	**Medium to High Strength Sandstone**	0.26 to 3.08	18.00 to 24.54	-[3]	Slightly weathered to fresh, medium to high strength, fine to medium grained sandstone. Areas of core loss were observed within BH9, core loss usually infers the presence of extremely weathered zones and seams.

Note 1 Approximate depth and level at the time of our investigation. Depths and levels may vary across the site.
Note 2 For more detailed descriptions of the subsurface conditions, reference should be made to the borehole logs attached to **Appendix A.**
Note 3 Observed up to termination depth in all boreholes

The footing thicknesses and the subsurface ground conditions encountered beneath the investigated footings are outlined in **Table 3-2** below. EI recommends that further investigation is conducted at the location of BH4 (Column 58) and BH10 (Column 154) as in-situ ground conditions at the founding level of the existing footing could not be identified during our investigation.

Table 3-2 Footing Thicknesses and Encountered Conditions at Founding Level

Borehole	Column Number	Observed Footing thickness (mm)	Strength of Rock Underlying Existing Footing
BH1	7	350	High Strength Sandstone
BH2	24	500	High Strength Sandstone
BH3	31	1130	Medium Strength Sandstone
BH4	58	850	Not Confirmed
BH5	65	450	Medium Strength Sandstone

Borehole	Column Number	Observed Footing thickness (mm)	Strength of Rock Underlying Existing Footing
BH6M	88	690	High Strength Sandstone
BH7	81	680	High Strength Sandstone
BH8	114	740	Medium Strength Sandstone
BH9	N/A	N/A	Medium Strength Sandstone
BH10	154	Not Observed	Medium Strength Sandstone
BH11	N/A	N/A	High Strength Sandstone

3.2 Groundwater Observations

Water circulation required for rock coring prevented observations of groundwater levels within all boreholes during drilling operation. Following completion of the drilling, groundwater monitoring wells were installed in BH6M, BH8M and BH11M and bailed dry. The groundwater levels were then measured within the monitoring wells as per **Table 3-3** below. No long term groundwater monitoring was carried out.

Table 3-3 Groundwater Levels

Borehole ID	Measurement Date	Depth to Groundwater (m BEGL)	Groundwater RL (m AHD)
BH6M	19/6/20	3.85	18.85
BH8M	19/6/20	4.48	19.12
BH11M	19/6/20	4.80	20.00

3.3 Test Results

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

- Soil aggressivity (pH, chloride and sulfate content and electrical conductivity).

A summary of the soil test results is provided in **Table 3-4** below. Laboratory test certificates are presented in **Appendix B**.

Table 3-4 Summary of Soil Laboratory Test Results

Test/ Sample ID		BH3_2.45-2.49	BH7_0.35-0.45
Unit		2	1
Material Description [1]		SANDSTONE	FILL
Aggressivity	Chloride Cl (ppm)	2.6	11
	Sulfate SO_4 (ppm)	7.4	510
	pH	6.5	6.8
	Electrical Conductivity (µS/cm)	8	190

Note 4 More detailed descriptions of the subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**.

The investigation indicated high permeability fill was present above the groundwater table. In accordance with Tables 6.4.2(C) and 6.5.2(C) of AS 2159:2009 'Piling – Design and Installation', the results of the pH, chloride and sulfate content and electrical conductivity of the soil provided the following exposure classifications:

- 'Non-Aggressive' for buried concrete structural elements; and
- 'Non-Aggressive' for buried steel structural elements.

In accordance with Table 4.8.1 of AS3600-2009 'Concrete Structures' these soils would be classified as exposure classification 'A1' for concrete in sulfate soils.

47 selected rock core samples were tested by Macquarie to estimate the Point Load Strength Index (Is_{50}) values to assist with rock strength assessment. The results of the testing are summarised on the attached borehole logs.

The point load strength index tests correlated reasonably well with our field assessments of rock strength. The approximate Unconfined Compressive Strength (UCS) of the rock core, estimated from correlations with the point load strength index test results, varied from <1 MPa to 37 MPa.

4. Recommendations

4.1 Geotechnical Issues

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

- Additional basement level excavation and retention to limit lateral deflections and ground loss as a result of excavations, resulting in damage to the existing structure;
- Rock excavation; and
- Foundation design for building loads.

4.2 Dilapidation Surveys

Prior to excavation of the additional basement level, 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 Demolition Considerations

Care should be taken during demolition, particularly the concrete pavement, to avoid damaging the existing structure. Demolition of concrete slabs, pavement and floor slabs may require breaking into smaller size prior to disposal offsite. We recommend that saw cut slots be provided near adjoining columns to reduce the risk of vibrations being transferred to the existing structure.

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 an excavation depth of about 3.00m BEGL. Locally deeper excavations for footings and service trenches 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.

Unit 1 could be excavated using buckets of earthmoving Hydraulic Excavators, particularly if fitted with ‘Tiger Teeth’. Excavation of Unit 2 may present hard or heavy ripping, or “hard rock” excavation conditions. Hydraulic rock breakers, rock saws, ripping hooks or rotary grinders are recommended for this site, as access for bulldozers or large construction equipment is not expected to be possible, though productivity may be low and equipment wear will be high, which 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.

Also, there is a potential for poorly oriented defects within the excavated bedrock to result in localized rock slide/topple failure with potential impact to the work site or the adjacent structures. However through selection of suitable excavation equipment, geotechnical inspections and mapping during the excavation works along with the installation of support measures as determined necessary by the inspections, the risk from the proposed works can be maintained within ‘Acceptable’ levels. In addition, we recommend that only excavation contractors with appropriate insurances and experience on similar projects be used. The contractor should also be provided with a copy of this report to make his own judgement on the most appropriate excavation equipment.

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 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 excavation to a depth of 1.5m, and every 1.5m interval thereafter;
- After excavation to the base of the excavation;
- 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 all monitoring wells as detailed in **Table 3-3**, all of which are above the assumed bulk excavation levels of RL 17.80m and RL 18.50m.

We expect that some groundwater inflows into the excavation through any defects within the sandstone bedrock (such as jointing, and bedding planes, etc.) may be possible, particularly following a period of heavy rainfall. Flows into the excavation at time 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.

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.

No architectural plans were provided at the time of writing of this report, however EI understands that excavation of up to 3.00m BEGL is expected to occur in the southern portion of the site, in places adjacent to the footings of the existing structure.

Allowance must be made for the retention of any fill layers beneath the existing slab, such as a concrete block wall or similar.

Excavation within Unit 2 sandstone should generally be able to be cut vertically and without support. For vertical cuts, the excavations must be inspected by a geotechnical engineer at regular intervals to check for any inclined joints or weak seams that require stabilisation. Said inclined joints and weak seams were evident in the boreholes, particularly in BH9. Such geotechnical inspections should be carried out at depth intervals of no more than 1.5m. If adverse defects are encountered, the stabilisation measures may comprise rock bolts, shotcrete and mesh or dental treatment of thin weak seams using non-shrink grout, and this should be allowed for.

Table 4-1 Geotechnical Design Parameters

Material [1]		Unit 1 Fill	Unit 2 Medium to High Strength Sandstone
RL of Top of Unit (m AHD) [2]		19.10 to 24.80	18.00 to 24.54
Bulk Unit Weight (kN/m^3)		18	24
Friction Angle, ϕ' (°)		25	-
Earth Pressure Coefficients	At rest, K_o [3]	0.58	-
	Active, K_a [3]	0.41	-
	Passive, K_p [3]	-	4.60
Allowable Bearing Pressure (kPa) [5]		-	3500
Allowable Shaft Adhesion (kPa) [4, 5]	in Compression	-	350
	in Uplift	-	175
Allowable Toe Resistance (kPa)		-	350
Allowable Bond Stress (kPa)		-	300
Earthquake Site Risk Classification		▪ AS 1170.4:2007 indicates an earthquake subsoil class of Class B_e.(Rock) ▪ 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

The subsurface conditions at the investigated locations have been grouped into three categories;

- Column footings founded on Unit 2, medium to high strength sandstone;
- Column footings requiring additional investigation; and
- Footings for the southern and south western retaining walls.

Recommendations are also provided for footings adjacent to the proposed vertical cuts in Unit 2 sandstone and new footings required for the proposed structural modifications.

4.7.1 Column Footings Founded on Medium to High Strength Sandstone

Based on the findings of our investigation, the footings for Column 7 (BH1), Column 24 (BH2), Column 31 (BH3), Column 65 (BH5), Column 88 (BH6M), Column 81 (BH7), Column 114 (BH8) and Column 154 (BH10) are founded upon sandstone bedrock of medium to high strength (Unit 2) and can be redesigned for an allowable bearing capacity of 3500kPa subject to serviceability. **Figure 3** provides an indicative cross section for the above column footings based on the encountered conditions at Column 24 (BH2).

4.7.2 Column Footings Requiring Additional Investigation

The findings of our investigation were inconclusive as to the founding conditions beneath the footings for Column 58 (BH4) and Colum 154 (BH10).

At the location of Column 58 (BH4), a concrete footing was encountered between 0.40m to 1.25m depth BEGL, underlain by a zone of core loss, inferred to be gravelly sand fill.

At the location of Column 154 (BH10), no footing was encountered, however medium and high strength sandstone was encountered at 0.90m depth BEGL.

In the central portion of the eastern boundary, reference Footing Plan – North (Sheet S2, Number in Set 64) identifies the approximate line of a rock shelf after bulk excavation to the east of Column 58 (BH4). There is a possibility that the footing for Column 58 is founded adjacent to the crest of this rock shelf and during drilling, BH4 has cut through a section close to the outer edge of the footing, hence the 1.55m of encountered fill is inferred to be directly adjacent to the footing. **Figure 4** provides a cross section of the inferred ground conditions beneath Column 58 (BH4). The presence of the Sandstone (of unknown strength) directly below the footing is inferred, as sandstone bedrock was not encountered in the borehole at the founding level of the footing.

EI recommends further investigation at Column 154 to obtain footing dimensions and further investigation in the vicinity of Colum 58 to identify the location of this rock ledge, as the footing location in regards to the rock ledge may affect the footings ability to take additional loads. Depending on the location of this rock ledge, this may impact other footings along the eastern portion of the site also.

4.7.3 Footings for Southern and South Western Retaining Walls

Boreholes BH9 and BH11M were drilled in the south western portion of site, to provide advice for the proposed footings for the southern and south western retaining walls.

Footings in the south western portion of site for the above mentioned retaining walls, founded on Unit 2 sandstone can be designed for an allowable bearing pressure of 3500kPa subject to 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.

4.7.4 Footings Adjacent to Proposed or Existing Vertical Cuts in Sandstone

Footings founded in Unit 2, medium to high strength sandstone located at the crest of a vertical cut, such as adjacent to the proposed basement or along the eastern portion of site as mentioned in **Section 4.7.2** above, can be designed for half the allowable bearing capacity, subject to serviceability, as outlined in **Table 4-1** above.

Where new excavation is occurring, geotechnical inspection of the rock cut face directly below the footings is recommended after excavation to 1.0m to check for any adverse defects or weak seams. If adverse defects are encountered, stabilisation measures may comprise of rock bolts or dental treatment of thin weak seams using non-shrink grout, and this should be allowed for.

4.7.5 New Footings

Following bulk excavation to 3.00m BEGL, we expect Unit 2 material to be exposed at BEL.

It is recommended that all new footings for the building be founded within the sandstone bedrock of similar strength of at least Unit 2 or better to provide uniform support and reduce the potential for differential settlements.

Pad or strip footings founded within Unit 2 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.

4.8 Basement Floor Slab

Following bulk excavations for the proposed additional basement level, 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:

- Dilapidation surveys;
- Classification of all excavated material transported off site;
- Additional Investigation at the location of Column 154 (BH10) to determine the dimensions of the existing footing;
- Additional Investigation in the eastern portion of the site, near Column 58 (BH4) to determine the location of the sandstone rock ledge;
- Geotechnical inspections of rock faces during excavation by an experienced geotechnical professional at depth intervals of no greater than 1.5m as required within medium to high strength bedrock, if vertical cut are adopted;
- 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 Mr John Green and Sirius Developments 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 Mr John Green and Sirius Developments 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 have 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

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

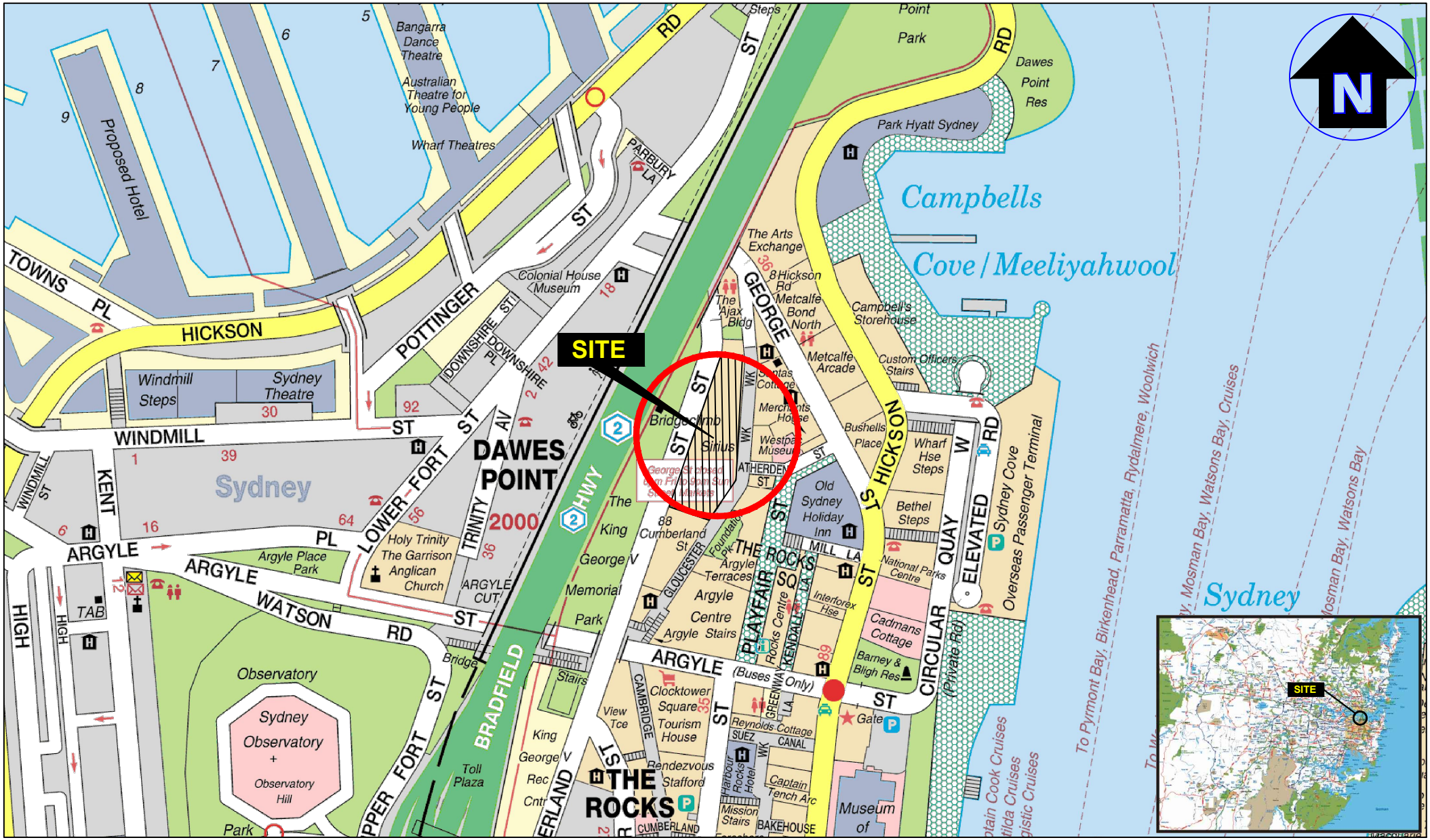
NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

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



Drawn:	AM.H.
Approved:	S.R.
Date:	15-06-20
Scale:	Not To Scale

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Additional Geotechnical Investigation
2-60 Cumberland Street, The Rocks NSW
Site Locality Plan

Figure: 1

Project: E24614.G03

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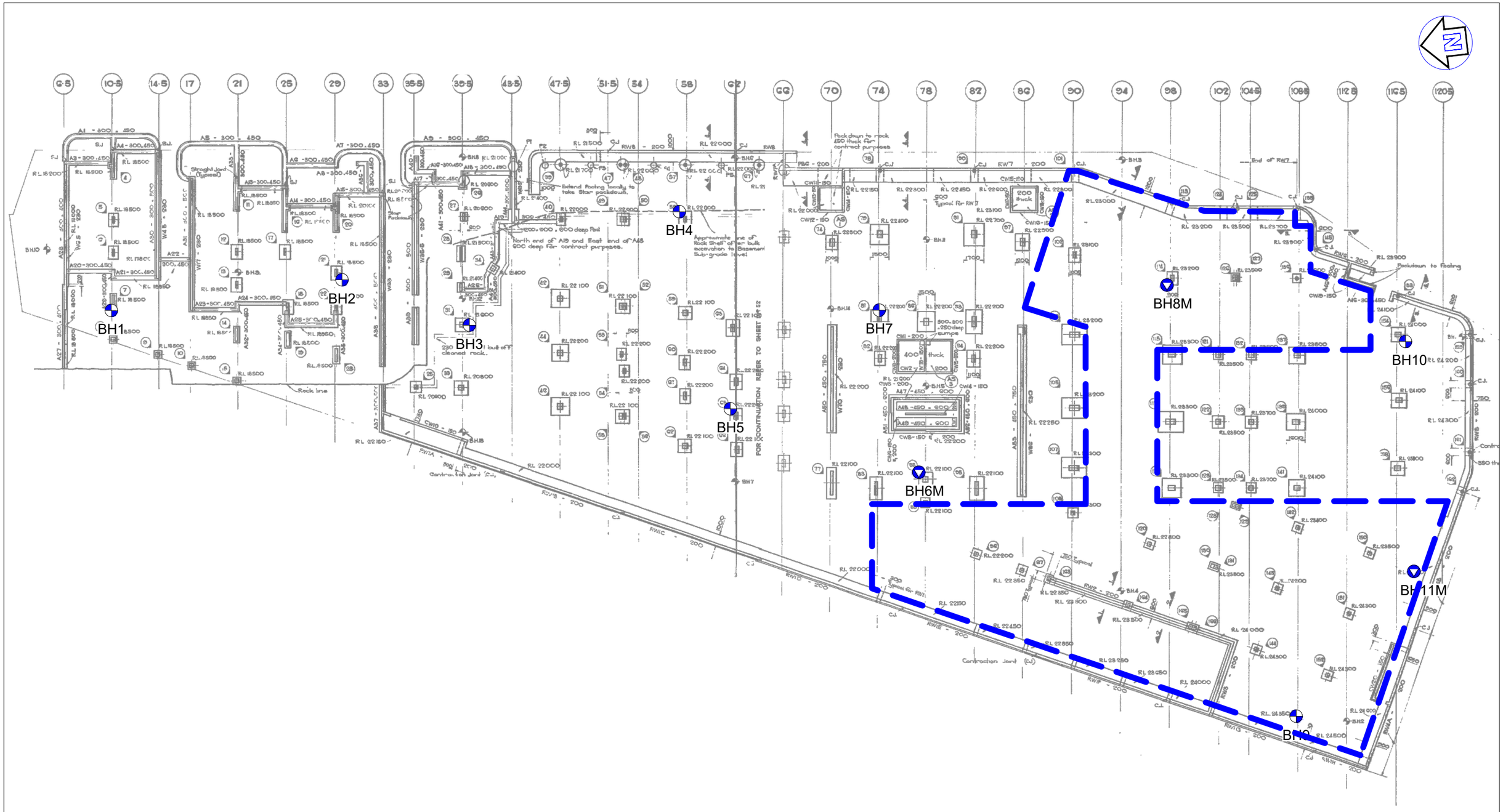

Map Source: The Housing Comission, ref No: 64, Sheet No: S2 and S3

LEGEND

- Proposed basement boundary
- Approximate borehole location
- Approximate borehole/monitoring well location

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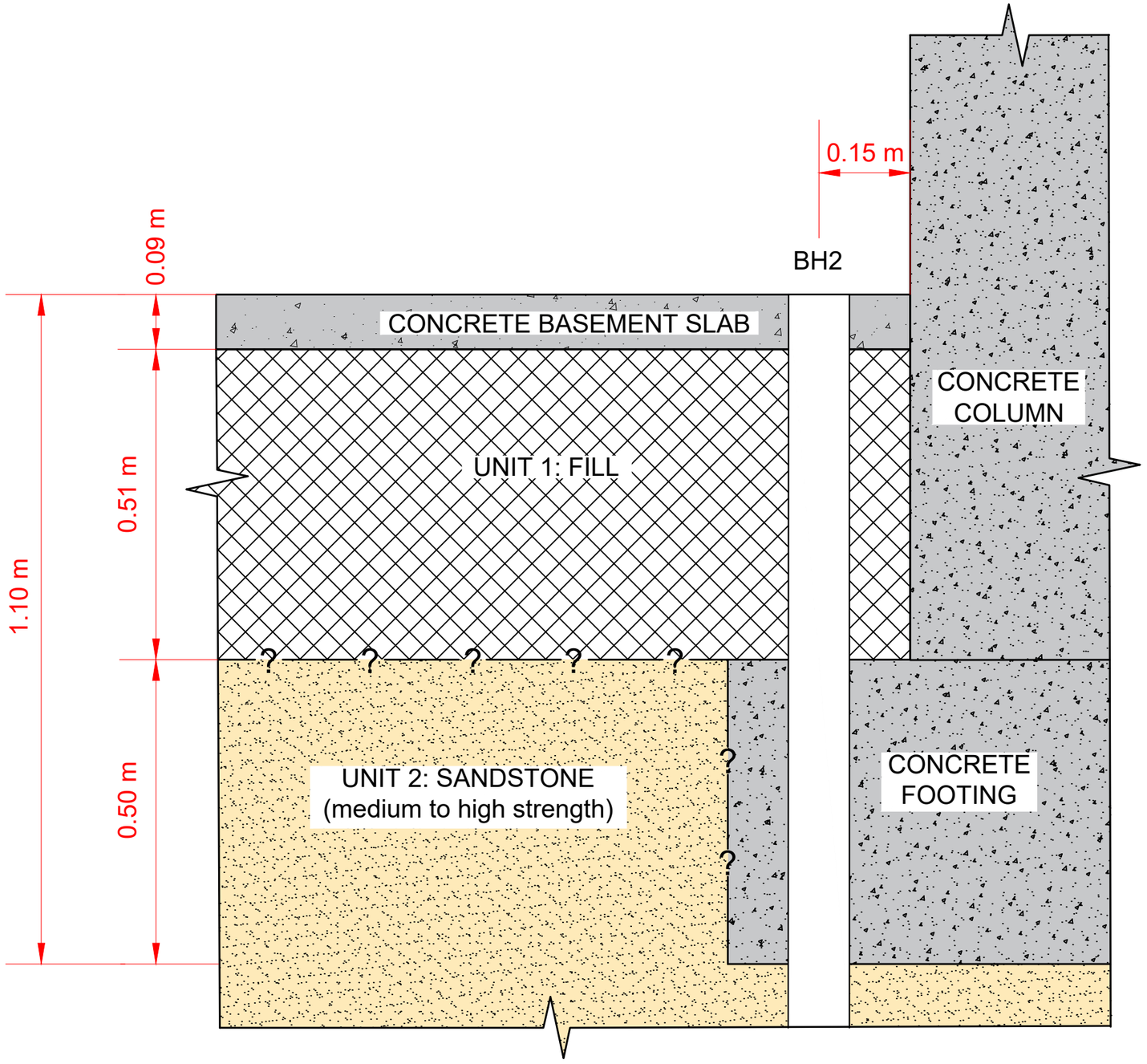
Sirius Developments Pty Ltd
Additional Geotechnical Investigation
2-60 Cumberland Street, The Rocks NSW
Borehole Location Plan

Figure: 2

Project: E24614.G03_Rev1



LEGEND

- CONCRETE
- FILL
- SANDSTONE

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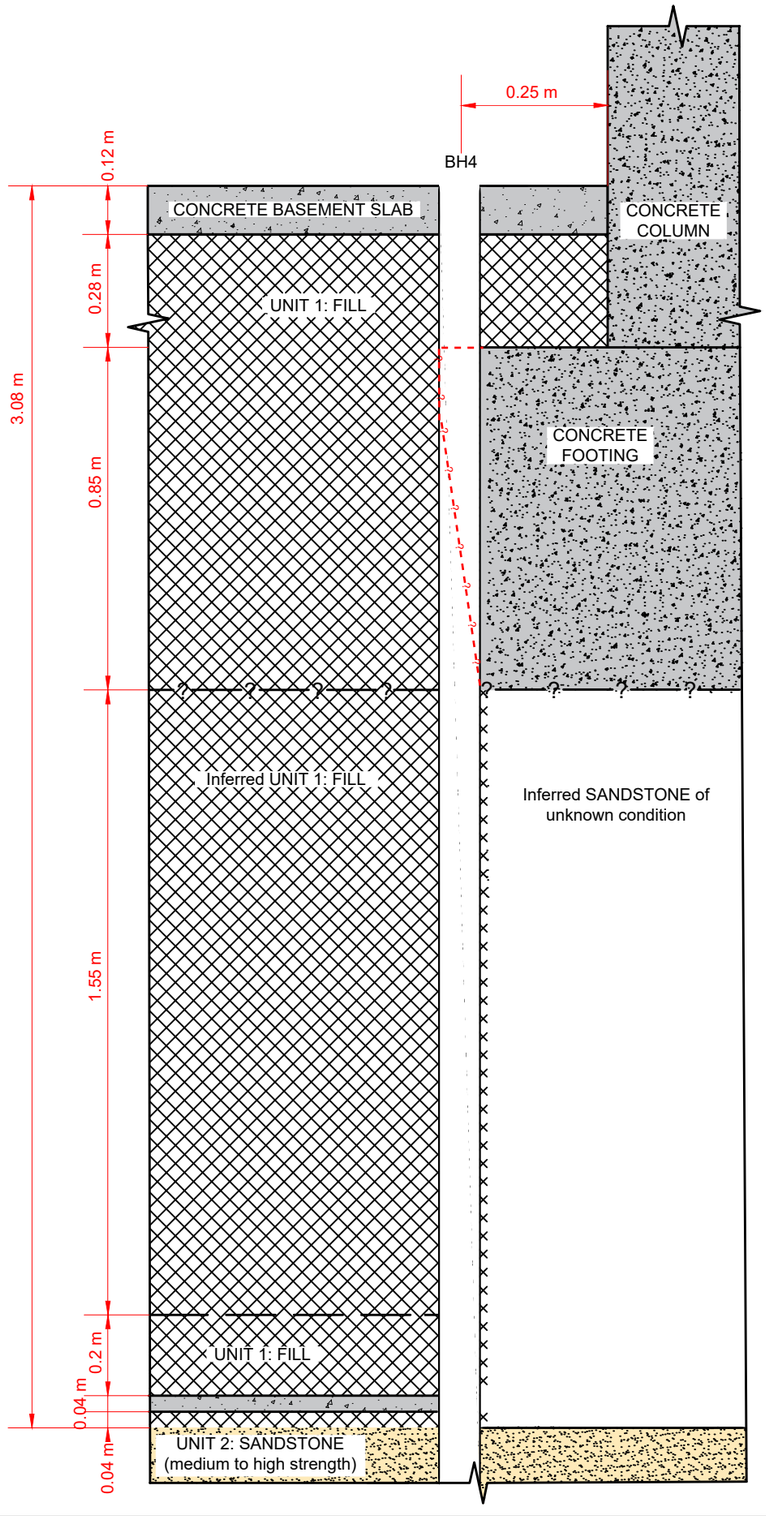
Date:	26.6.20

Sirius Developments Pty Ltd
Geotechnical Investigation
2-60 Cumberland Street, The Rocks NSW
Footing Cross Section at Column 24 (BH2)

Figure: 3

Project: E24614.G03



LEGEND

- CONCRETE
- FILL
- SANDSTONE

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Approved:	S.R
Date:	26.6.20

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Geotechnical Investigation
2-60 Cumberland Street, The Rocks NSW
Footing Cross Section at Column 58 (BH4)

Figure: 4

Project: E24614.G03

Appendix A – Borehole Logs And Explanatory Notes

CORED BOREHOLE LOG

BH NO. BH1

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	02/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 02/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	TJ Core Drilling	**Surface RL**	≈19.10 m AHD
Drill Rig	Hand Portable	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00 19.10		CONCRETE; 100 mm thick concrete slab.	-			
HAND DT		-	-				FILL: Gravelly SAND; fine to medium grained sand, grey, fine to coarse, angular to sub-angular sandstone gravels, with some sandstone cobbles, moist.				
		100	-		0.65 18.45		CONCRETE; 350 mm thick concrete footing.				
		100	80	1	1.00 18.10		SANDSTONE; high strength, pale grey, fine to medium grained, pale grey, medium bedded, high strength, fresh.	FR			
DT	0% RETURN	100	93	2							
		100	85	3							
				4	4.00 15.10		Borehole Terminated at 4.00 m, Target Depth Reached.				
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH1

Project	Proposed Residential Development			**Depth Range**	0.0m to 4.0m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	TJ Core Drilling		
Position	See Figure 2	**Surface RL**	≈ 19.1m	**Drill Rig**	Hand portable		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	02 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1 of 1	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH2

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	04/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	TJ Core Drilling	**Surface RL**	≈19.10 m AHD
Drill Rig	Hand Portable	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
HAND DT		-	-	0	*0.00* 19.01		CONCRETE; 90 mm thick concrete slab.	-			
		-	-		*0.40* 18.70		FILL: Sandy GRAVEL; fine to medium, angular to sub-angular gravels, grey-pale brown, moist.				
					0.60 18.50		FILL: Gravelly SAND; fine to coarse grained sand, grey, with some wood and metal fragments, moist.				
		100	100	1	*1.10* 18.00		CONCRETE; 500 mm thick concrete footing.	FR			
DT	0% RETURN	100	100	2			SANDSTONE; fine to medium grained, pale grey, medium bedded, high strength, fresh.				
		100	100	3							
		100	100	4	*4.24* 14.86		Borehole Terminated at 4.24 m, Target Depth Reached.				
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH2

Project	Proposed Residential Development			**Depth Range**	0.0m to 4.24m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	TJ Core Drilling		
Position	See Figure 2	**Surface RL**	≈ 19.1m	**Drill Rig**	Hand portable		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	04 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH3

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	04/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	TJ Core Drilling	**Surface RL**	≈22.60 m AHD
Drill Rig	Hand Portable	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00 0.12 22.45		CONCRETE; 150 mm thick concrete slab.	-			
HAND		-	-				FILL: Gravel; fine to medium, angular to sub-angular blue metal gravels, moist.				
				1	*0.95* 21.65		CONCRETE; 1130 mm thick concrete footing.				
DT	0% RETURN	100	-								
				2	*2.08* 20.52		SANDSTONE; fine to medium grained, pale grey, thinly bedded, medium strength, fresh.	FR			
		78	77								
		100	51	3							
		100	80								
		100	88	4	*4.82* 17.78		Borehole Terminated at 4.82 m, Target Depth Reached.				
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH3

Project	Proposed Residential Development			**Depth Range**	0.0m to 4.82m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	TJ Core Drilling		
Position	See Figure 2	**Surface RL**	≈ 22.6m	**Drill Rig**	Hand portable		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	04 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH4

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	05/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 05/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈22.40 m AHD
Drill Rig	Tight Access	**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	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm)
HAND DT		-	-	0	0.00		CONCRETE; 120 mm thick concrete slab.	-			
		-	-		22.18						
					0.40		FILL: Sandy GRAVEL; fine to medium, angular to sub-angular blue metal gravels, moist, sand is fine to medium grained.				
					22.00		CONCRETE; 850 mm thick concrete footing.				
		100	-	1							
					1.25						
NMLC	0% RETURN				21.15		NO CORE; 1550 mm thick, inferred to be gravelly sand fill.				
		15	0	2							
					2.80						
					19.60		FILL: Gravelly SAND; fine to medium grained sand, with metal fragments.				
				3	3.00						
					19.32		CONCRETE; 40 mm thick concrete slab.	FR			
		100	75				FILL: Sandy GRAVEL; fine to medium, angular to sub-angular gravels, sand is fine to medium grained.				
							SANDSTONE; fine to medium grained, pale grey, medium bedded, medium to high strength, fresh.				
					4.00						
		100	0	4	18.40		Borehole Terminated at 4.00 m, Target Depth Reached.				
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH4

Project	Proposed Residential Development			**Depth Range**	0.0m to 4.0m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	TJ Core Drilling		
Position	See Figure 2	**Surface RL**	≈ 22.4m	**Drill Rig**	Hand portable		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	05 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1 of 1	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH5

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	04/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈22.60 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
HAND DT		-	-	0	0.00 0.14		CONCRETE; 140 mm thick.	-			
		-	-		22.46 0.39		FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, grey, moist.	-			
		100	-		22.21		CONCRETE; 450 mm thick concrete footing.	-			
					0.84						
NMLC	90% RETURN	100	100	1	21.76		SANDSTONE; fine to medium grained, pale grey-pale brown, medium bedded, medium strength, slightly weathered to fresh.	FR		0.84: JT, 70°, Clay, UN, VR	
					1.35						
		100	82	2	21.25		From 1.35 m, grading to high strength.	SW		2.29: BP, 5°, Clay, PR, RF, 5 mm	
					2.72						
		100	92	3	19.88		From 2.72 to 2.92 m, dark grey, distinctly weathered, very low strength shale layer.	DW FR		3.48: BP, 5°, Clay, PR, RF, 5 mm 3.61: BP, 5°, Clay, PR, RF, 5 mm	
					3.69						
					18.91		Borehole Terminated at 3.69 m, Target Depth Reached.				
				4							
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH5

Project	Proposed Residential Development			**Depth Range**	0.0m to 3.69m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 22.6m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	04 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1 of 1	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH6M

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Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	04/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈22.70 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00		CONCRETE; 190 mm thick concrete slab.	-			
HAND		-	-		0.19 0.30 22.40		FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, with some fine to medium sand, moist.	-			
					0.55 22.15		FILL: Gravelly SAND; fine to coarse grained, pale brown, moist, gravel is fine to coarse, angular to sub-angular, sandstone gravels.	-			
		100	-	1			CONCRETE; 690 mm thick concrete footing.				
					1.24 21.46		SANDSTONE; fine to medium grained, pale brown, medium bedded, high strength, slightly weathered.	SW			
NMLC	90% RETURN	100	84	2							
		100	65							2.30: JT, 80°, Clay, UN, VR	
										2.82: JT, 40°, Clay, UN, VR	
				3	3.10 19.60		From 3.1 m, medium strength, thinly bedded.			3.09: JT, 30°, Clay, PR, VR	
		100	55							3.39: JT, 40°, Clay, PR, VR	
					3.70					3.58-3.60: XWS, Clay, 20 mm	
					19.00		From 3.7 m, grading to high strength, medium bedded, fresh.	FR		3.65-3.67: XWS, Sand, 20 mm	
	0% RETURN	100	99	4							
				5						5.00-5.02: XWS, Clay, 20 mm	
		100	99	6						6.48-6.49: XWS, Clay, 10 mm	
					6.82 15.88		Borehole Terminated at 6.82 m, Target Depth Reached.				
				7							
				8							
				9							
				10							

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

MONITORING WELL LOG

MW NO. BH6M

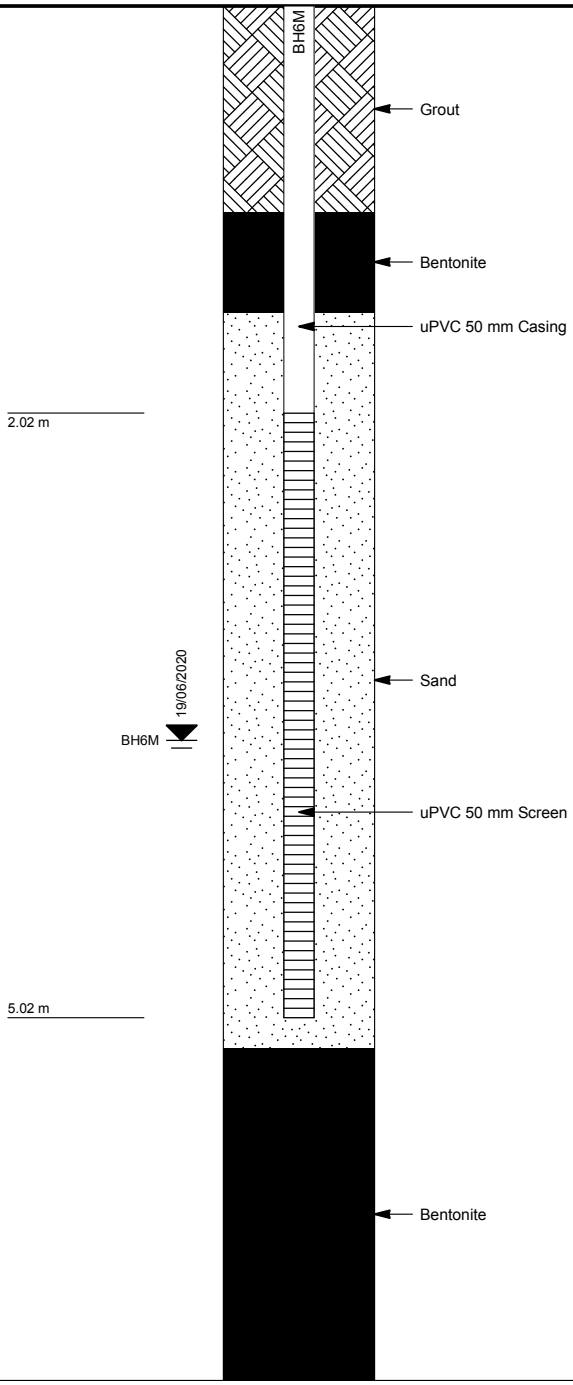
Project	Proposed Residential Development	**Sheet**	1 of 2
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	04/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈22.70 m AHD
Drill Rig	Tight Access	**Inclination**	-90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
DT		0			CONCRETE; 190 mm thick concrete slab.
HAND					FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, with some fine to medium sand, moist.
					FILL: Gravelly SAND; fine to coarse grained, pale brown, moist, gravel is fine to coarse, angular to sub-angular, sandstone gravels.
			22		CONCRETE; 690 mm thick concrete footing.
		1			SANDSTONE; fine to medium grained, pale brown, medium bedded, high strength, slightly weathered.
			21		
		2			
			20		
		3			From 3.1 m, medium strength, thinly bedded.
NMLC	19/06/20		19		From 3.7 m, grading to high strength, medium bedded, fresh.
		4			
			18		
		5			
			17		
		6			
			16		
		7			Borehole Terminated at 6.82 m, Target Depth Reached.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH6M	Standpipe	0.12 m 22.58 m	5.02 m 17.68 m		



This well log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH6M

Project	Proposed Residential Development			**Depth Range**	0.0m to 6.82m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 22.70m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	04 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH7

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	05/06/2020
Position	Refer to Figure 2	**Date Completed**	05/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 05/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈22.80 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00 0.14 22.66		CONCRETE; 140 mm thick concrete slab.				
HAND		-	-				FILL: Sandy GRAVEL; fine to medium grained, angular to sub-angular blue metal gravels, with metal fragments, moist, sand is fine to medium grained.				
					0.80 22.00		CONCRETE; 680 mm thick concrete footing.				
NMLC	100% RETURN	-	-	1	1.48 21.32		SANDSTONE; fine to medium grained, pale grey, medium bedded, high strength, fresh.	FR			
		100	75	2							
		100	94	3							
					3.65 19.15		From 3.65 m, thinly bedded.				
		100	67	4	4.05 18.75		From 4.05 m, medium bedded.			4.63: BP, 5°, Clay, PR	
					4.90 17.90		Borehole Terminated at 4.90 m, Target Depth Reached.				
				5							
				6							
				7							
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH7

Project	Proposed Residential Development			**Depth Range**	0.0m to 4.9m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 22.8m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	05 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH8M

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	03/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈23.60 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
HAND DT		-	-	0	0.00 0.15 23.45		CONCRETE; 150 mm thick concrete slab.	-			
		-	-		0.49 23.11		FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, with some sand, brick and sandstone fragments, moist.	-			
		100	-	1	1.23		CONCRETE; 740 mm thick concrete footing.	-			
NMLC		100	100		22.37		SANDSTONE; pale grey-pale brown, medium bedded, medium strength, slightly weathered.	SW		1.44: BP, 5°, Clay, PR, RF, 2 mm	
		100	94	2							
		100	89	3	3.20 20.40		From 3.2 m, pale grey, fresh.	FR		3.74-3.77: XWS, Clay, 30 mm 3.90-3.92: XWS, Clay, 20 mm	
	03/06/20	100	89	4						4.34-4.38: XWS, Clay, 40 mm	
		100	45	5	5.48 18.12 5.85 17.75		From 5.48 m, thinly bedded. From 5.85 m, high strength.				
				6	6.45						
				7	17.15		Borehole Terminated at 6.45 m, Target Depth Reached.				
				8							
				9							
				10							

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

MONITORING WELL LOG

MW NO. BH8M

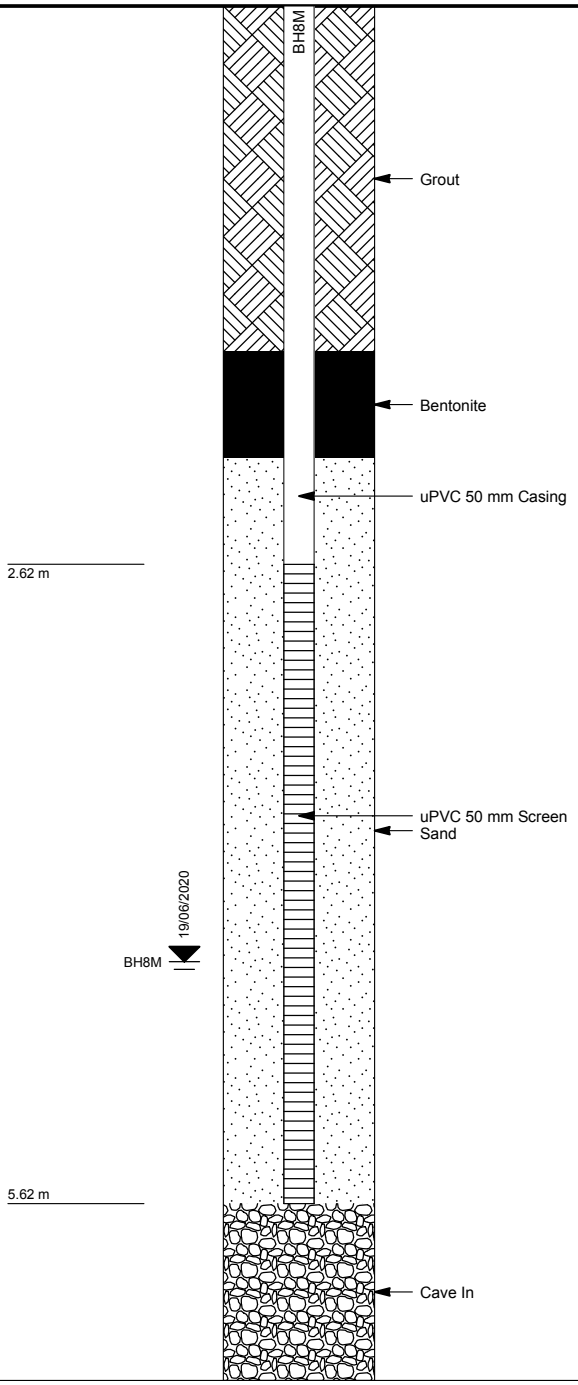
Project	Proposed Residential Development	**Sheet**	1 of 2
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	03/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 04/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈23.60 m AHD
Drill Rig	Tight Access	**Inclination**	-90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
DT		0			CONCRETE; 150 mm concrete slab.
HAND					FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, with some sand, brick and sandstone fragments, moist.
			23		CONCRETE; 740 mm thick concrete footing.
		1			
			22		SANDSTONE; pale grey-pale brown, medium bedded, medium strength, slightly weathered.
		2			
			21		
		3			
NMLC					From 3.2 m, pale grey, fresh.
			20		
	19/06/20	4			
			19		
		5			
			18		From 5.48 m, thinly bedded.
					From 5.85 m, high strength.
		6			
			17		Borehole Terminated at 6.45 m, Target Depth Reached.
		7			

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH8M	Standpipe	0.08 m 23.52 m	5.62 m 17.98 m		



This well log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH8M

Project	Proposed Residential Development			**Depth Range**	0.0m to 6.45m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 23.6m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	03 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

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BH NO. BH9

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	02/06/2020
Position	Refer to Figure 2	**Date Completed**	04/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 02/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	TJ Core Drilling	**Surface RL**	≈24.80 m AHD
Drill Rig	Hand Portable	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT	0% RETURN	-	-	0	0.00		CONCRETE; 150 mm thick concrete slab.	-			
		-	-		0.15						
					0.25		FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, with some fine to medium grained sand, moist.	SW			
					24.53						
		100	100				SANDSTONE; fine to medium grained, pale brown, medium bedded, medium strength, slightly weathered.				
				1							
		100	79								
					1.95						
				2	22.85		From 1.95 m, high strength.				
					3.01						
				3	21.77		NO CORE; 30 mm thick.	-			
								SW			
		98	88								
				4						3.94: JT, 70°, Clay, PR, VR	
					4.40						
					4.55		From 4.4 m, thinly bedded.				
					20.25		From 4.45 to 4.47 m, dark grey shale band.	-			
					4.82		NO CORE; 270 mm thick.				
		72	31	5	19.98			SW			
					5.39			-			
					5.50						
							From 5.5 to 5.58 m, very low strength, distinctly weathered, dark grey shale band.	DW			
					19.16			-			
					19.16		NO CORE; 60 mm thick.	FR			
		100	23	6			From 5.64 m, grading to pale grey, medium strength, fresh.				
					6.15						
					18.60		NO CORE; 50 mm thick.	-			
								FR		6.48: JT, 90°, UN, VR	
		100	30	7							
										7.20: JT, 90°, UN, VR	
		100	87								
				8	8.20						
					16.60		Borehole Terminated at 8.20 m, Target Depth Reached.				
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH9

Project	Proposed Residential Development			**Depth Range**	0.0m to 8.2m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 24.8m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	02 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH10

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	02/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By**	IW **Date** 02/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By**	SK **Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈24.90 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00 0.15 24.75		CONCRETE; 150 mm thick concrete slab.				
		-	-				FILL: Sandy GRAVEL; pale brown, fine to coarse sandstone gravels, with concrete fragments and sandstone cobbles, moist, sand is fine to medium grained.				
					0.90 24.00		SANDSTONE; fine to medium grained, pale brown to red-brown, medium bedded, medium strength, slightly weathered.	SW			
NMLC	90% RETURN	100	85	1						1.83-1.86: XWS, Clay, 30 mm	
		100	89	2	2.15 22.75		From 2.15 m, high strength.				
		100	88	3						2.89: JT, 50°, Clay, IR, VR	
		100	81	4						4.72: BP, 5°, Clay, PR, 2 mm	
				5	5.70 19.20		From 5.7 m, grading to pale grey, fresh.	FR			
		100	62	6						5.84: JT, 70°, PR, VR 5.95: BP, 5°, Clay, PR, 1 mm	
					6.48 18.42		From 6.48 m, thinly bedded.				
				7	7.15 17.75		Borehole Terminated at 7.15 m, Target Depth Reached.				
				8							
				9							
				10							

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

CORE PHOTOGRAPH OF BOREHOLE: BH10

Project	Proposed Residential Development			**Depth Range**	0.0m to 7.15m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 24.9m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	02 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

CORED BOREHOLE LOG

BH NO. BH11M

Project	Proposed Residential Development	**Sheet**	1 OF 1
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	02/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 02/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈24.80 m AHD
Drill Rig	Tight Access	**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 (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
DT		-	-	0	0.00		CONCRETE; 160 mm thick concrete slab.	-			
HAND		-	-		0.16		FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, moist.	SW			
DT					0.29 24.54		SANDSTONE; fine to medium grained, pale brown to red-brown, medium bedded, high strength, slightly weathered.				
NMLC		100	87	1							
		100	83	2						1.44-1.50: XWS, Clay, 60 mm	
		100	98	3							
				4							
					4.88 19.92		From 4.88 m, grading to pale grey, fresh.	FR		4.93: BP, 10°, Clay, PR, VR, 10 mm	
		100	97	5	5.28 19.52		From 5.28 to 5.43 m, medium strength, distinctly weathered, dark grey, shale layer.			5.41-5.44: XWS, Clay, 30 mm	
	02/06/20			6						6.34: JT, 0 - 40°, Clay, CU, VR	
		100	71	7							
		100	86	8							
					8.47 16.33		Borehole Terminated at 8.47 m, Target Depth Reached.				
				9							
				10							

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

MONITORING WELL LOG

MW NO. BH11M

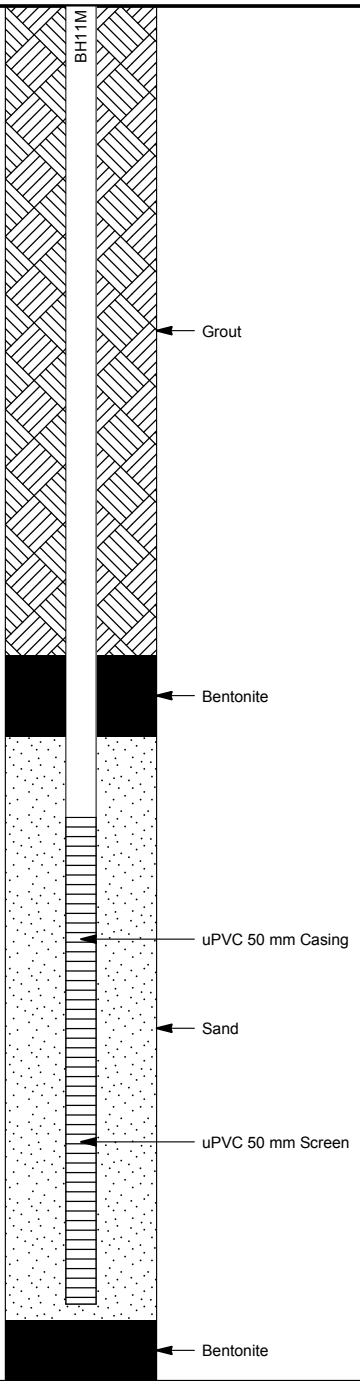
Project	Proposed Residential Development	**Sheet**	1 of 2
Location	2-60 Cumberland Street, The Rocks NSW	**Date Started**	02/06/2020
Position	Refer to Figure 2	**Date Completed**	03/06/2020
Job No.	E24614.G04	**Logged By** IW	**Date** 02/06/2020
Client	Sirius Developments Pty Ltd	**Reviewed By** SK	**Date** 15/06/2020

Drilling Contactor	Geosense Drilling	**Surface RL**	≈24.80 m AHD
Drill Rig	Tight Access	**Inclination**	-90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
DRANDT		0	24		CONCRETE; 160 mm thick concrete slab.
					FILL: GRAVEL; fine to medium, angular to sub-angular blue metal gravels, moist.
		1			SANDSTONE; fine to medium grained, pale brown to red-brown, medium bedded, high strength, slightly weathered.
			23		
		2			
			22		
		3			
			21		
		4			
NMLC	19/06/20		20		From 4.88 m, grading to pale grey, fresh.
		5			From 5.28 to 5.43 m, medium strength, distinctly weathered, dark grey, shale layer.
			19		
		6			
			18		
		7			
			17		
		8			
		9	16		Borehole Terminated at 8.47 m, Target Depth Reached.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH11M	Standpipe	0.10 m 24.70 m	8.00 m 16.80 m		



This well log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH11M

Project	Proposed Residential Development			**Depth Range**	0.0m to 8.47m BEGL		
Location	2-60 Cumberland Street, The Rocks NSW			**Contractor**	Geosense Drilling		
Position	See Figure 2	**Surface RL**	≈ 24.8m	**Drill Rig**	Tight Access		
Job No.	E24614.G04	**Inclination**	-90°	**Logged**	IW	**Date**	02 / 06 / 2020
Client	Sirius Developments Pty Ltd	**Box**	1-2 of 2	**Checked**	SK	**Date**	15 / 06 / 2020

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 (%)

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

RQD = Rock Quality Designation (%)

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

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			

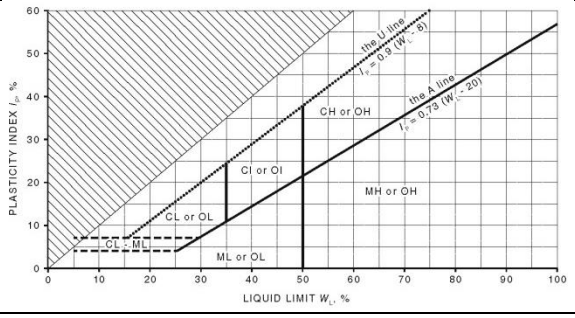
CLASSIFICATION AND INFERRED STRATIGRAPHY

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

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	48 Cumberland Street The Rocks (E24614 G03)	**Report No:**	S60678-PL
Job No:	S20263-1	**Date Tested:**	10/06/2020

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

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 9/06/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S60678	BH1 1.01 - 1.10m	Sandstone							
			Axial	44.7	38.0	2.65	1.23	1.19	1
S60679	BH1 2.45 - 2.54m	Sandstone							
			Axial	46.1	34.0	3.09	1.55	1.47	1
S60680	BH1 3.70 - 3.80m	Sandstone							
			Axial	45.6	35.0	1.98	0.97	0.93	1
S60681	BH2 1.13 - 1.21m	Sandstone							
			Axial	45.7	34.0	2.52	1.27	1.21	1
S60682	BH2 2.64 - 2.74m	Sandstone							
			Axial	45.3	41.0	3.27	1.38	1.37	1
S60683	BH2 4.13 - 4.23m	Sandstone							
			Axial	45.8	37.0	2.60	1.21	1.17	1
S60684	BH3 2.15 - 2.23m	Sandstone							
			Axial	45.8	32.0	1.51	0.81	0.76	1
S60685	BH3 3.63 - 3.72m	Sandstone							
			Axial	44.7	38.0	1.96	0.91	0.88	1
S60686	BH4 3.15 - 3.23m	Sandstone							
			Axial	52.1	40.0	2.15	0.81	0.82	1
S60687	BH4 3.75 - 3.85m	Sandstone							
			Axial	51.9	41.0	2.90	1.07	1.09	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

NATA

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

11/06/2020

Date

MACQUARIE GEOTECH

Macquarie Geotechn
U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	48 Cumberland Street The Rocks (E24614 G03)	**Report No:**	S60688-PL
Job No:	S20263-1	**Date Tested:**	10/06/2020

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

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 9/06/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S60688	BH5 1.00 - 1.09m	Sandstone							
			Axial	51.9	41.0	1.66	0.61	0.62	1
S60689	BH5 2.16 - 2.24m	Sandstone							
			Axial	51.9	41.0	2.96	1.09	1.11	1
S60690	BH5 2.84 - 2.90m	Shale							
			Axial	52.5	38.0	0.08	0.03	0.03	1
S60691	BH5 3.32 - 3.42m	Sandstone							
			Axial	52.0	42.0	4.09	1.47	1.51	1
S60692	BH6 1.30 - 1.40m	Sandstone							
			Axial	52.0	40.0	2.69	1.02	1.03	1
S60693	BH6 2.68 - 2.76m	Sandstone							
			Axial	52.1	41.0	2.72	1.00	1.02	1
S60694	BH6 3.46 - 3.55m	Sandstone							
			Axial	52.1	40.0	1.50	0.57	0.57	1
S60695	BH6 4.54 - 4.63m	Sandstone							
			Axial	51.9	32.0	3.30	1.56	1.50	1
S60696	BH6 5.52 - 5.61m	Sandstone							
			Axial	52.1	45.0	4.12	1.38	1.44	1
S60697	BH7 1.62 - 1.69m	Sandstone							
			Axial	51.8	41.0	2.95	1.09	1.11	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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11/06/2020

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	48 Cumberland Street The Rocks (E24614 G03)	**Report No:**	S60698-PL
Job No:	S20263-1	**Date Tested:**	10/06/2020

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

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 9/06/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S60698	BH7 2.24 - 2.34m	Sandstone							
			Axial	52.1	43.0	3.40	1.19	1.23	1
S60699	BH7 3.52 - 3.62m	Sandstone							
			Axial	51.5	45.0	3.13	1.06	1.10	1
S60700	BH8 1.23 - 1.33m	Sandstone							
			Axial	52.0	38.0	1.93	0.77	0.77	1
S60701	BH8 2.48 *- 2.58m	Sandstone							
			Axial	51.9	40.0	2.15	0.81	0.82	1
S60702	BH8 3.39 - 3.49m	Sandstone							
			Axial	52.0	41.0	1.58	0.58	0.59	1
S60703	BH8 4.16 - 4.26m	Sandstone							
			Axial	52.2	44.0	2.47	0.84	0.87	1
S60704	BH8 6.14 - 6.23m	Sandstone							
			Axial	52.1	35.0	4.35	1.87	1.84	1
S60705	BH9 0.28 - 0.37m	Sandstone							
			Axial	44.6	40.0	1.83	0.81	0.79	1
S60706	BH9 1.46 - 1.55m	Sandstone							
			Axial	45.3	38.0	2.22	1.01	0.98	1
S60707	BH9 2.33 - 2.41m	Sandstone							
			Axial	45.4	37.0	3.80	1.78	1.71	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	48 Cumberland Street The Rocks (E24614 G03)	**Report No:**	S60708-PL
Job No:	S20263-1	**Date Tested:**	10/06/2020

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

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 9/06/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S60708	BH9 3.24 - 3.33m	Sandstone							
			Axial	45.4	40.0	4.24	1.83	1.80	1
S60709	BH9 4.09 - 4.18m	Sandstone							
			Axial	45.2	40.0	2.32	1.01	0.99	1
S60710	BH9 5.50 - 5.57m	Shale							
			Axial	45.1	30.0	0.13	0.08	0.07	1
S60711	BH9 5.80 - 5.90m	Sandstone							
			Axial	45.4	32.0	1.86	1.00	0.94	1
S60712	BH9 7.43 - 7.53m	Sandstone							
			Axial	46.0	40.0	2.22	0.95	0.93	1
S60713	BH10 1.00 - 1.10m	Sandstone							
			Axial	52.0	33.0	1.43	0.65	0.64	1
S60714	BH10 2.57 - 2.67m	Sandstone							
			Axial	51.9	41.0	3.50	1.29	1.32	1
S60715	BH10 3.30 - 3.40m	Sandstone							
			Axial	52.1	40.0	2.46	0.93	0.94	1
S60716	BH10 4.32 - 4.41m	Sandstone							
			Axial	51.9	41.0	3.07	1.13	1.15	1
S60717	BH10 5.42 - 5.52m	Sandstone							
			Axial	51.9	36.0	3.97	1.67	1.65	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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11/06/2020

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	48 Cumberland Street The Rocks (E24614 G03)	**Report No:**	S60718-PL
Job No:	S20263-1	**Date Tested:**	10/06/2020

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

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 9/06/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S60718	BH10 6.37 - 6.47m	Sandstone							
			Axial	51.9	40.0	3.75	1.42	1.44	1
S60719	BH11 0.42 - 0.50m	Sandstone							
			Axial	51.8	36.0	3.24	1.36	1.35	1
S60720	BH11 2.53 - 2.63m	Sandstone							
			Axial	51.9	40.0	3.34	1.26	1.28	1
S60721	BH11 4.52 - 4.60m	Sandstone							
			Axial	51.9	42.0	3.16	1.14	1.17	1
S60722	BH11 5.30 - 5.38m	Shale							
			Axial	52.0	34.0	0.73	0.32	0.32	1
S60723	BH11 6.52 - 6.62m	Sandstone							
			Axial	51.8	38.0	3.97	1.58	1.58	1
S60724	BH11 8.31 - 8.39m	Sandstone							
			Axial	52.0	43.0	4.42	1.55	1.60	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

NATA

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

12/06/2020

Date

MACQUARIE GEOTECH

Macquarie Geotechn
U7/8 10 Bradford Street
Alexandria NSW

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Ian Watts
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 95160722
Facsimile	(Not specified)
Email	ian.watts@eiaustralia.com.au
Project	**E24614 48 Cumberland StreetThe Rocks**
Order Number	**E24614**
Samples	13

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
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SGS Reference	**SE207287A R0**
Date Received	10/6/2020
Date Reported	17/6/2020

COMMENTS

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

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

pH in soil (1:5) [AN101] Tested: 15/6/2020

PARAMETER	UOM	LOR	BH3_2.45-2.49 SOIL - 4/6/2020 SE207287A.003	BH7_0.35-0.45 SOIL - 5/6/2020 SE207287A.008
pH	pH Units	0.1	**6.5**	**6.8**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 15/6/2020

PARAMETER	UOM	LOR	BH3_2.45-2.49 SOIL - 4/6/2020 SE207287A.003	BH7_0.35-0.45 SOIL - 5/6/2020 SE207287A.008
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	8	190

Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 16/6/2020

PARAMETER	UOM	LOR	BH3_2.45-2.49 SOIL - 4/6/2020 SE207287A.003	BH7_0.35-0.45 SOIL - 5/6/2020 SE207287A.008
Chloride	mg/kg	0.25	**2.6**	**11**
Sulfate	mg/kg	5	**7.4**	**510**

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

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

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

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

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

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

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

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

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

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

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

 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.