PLATINUM RESTAURANT GROUP

Preliminary Geotechnical Investigation Report

175 Cleveland Street, Redfern, NSW

Report No. E22434 GA

18 March 2015

Environmental Investigations Australia

Contamination | Remediation | Geotechnical

Report Distribution

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Date: *18 March 2015*

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CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 BACKGROUND

At the request of Platinum Restaurant Group (PRG), Environmental Investigations Australia Pty Ltd (EI) has carried out a Preliminary Geotechnical Investigation (PGI) for the proposed development at 175 Cleveland Street in Redfern, NSW (the Site).

This PGI report has been prepared to provide preliminary geotechnical advice and recommendations in support of a Development Application (DA) and the preparation of initial concept designs for the proposed mixed-use development. Work has been carried out in accordance with the scope of works outlined in our proposal referenced P12787.1, dated 28 October 2014, and the authorisation to proceed dated 6 February 2014.

1.2 PROPOSED DEVELOPMENT

JPR Architects Pty Ltd (JPR) supplied EI with pre-DA concept drawings:

- *Basement Level 02* to *Level 07 Loft*, Project No. 2014067, Drawing No. SK02 to SK09, Revision A, dated 8 October 2014; and
- *Section A* and *Section B*, Project No. 2014067, Drawing No. SK11 and SK12, Revision A, dated 29 September 2014.

Based on the drawings provided, EI understands that the proposed development will involve the construction of an eight-storey building over a two-storey basement car park. We expect that the basement will extend to a maximum depth of approximately 9.0 m below existing ground level (mBGL) adjacent to Cleveland Street.

1.3 INVESTIGATION OBJECTIVES

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

- Building and retaining wall foundation options, including;
  - Preliminary design parameters;
  - Earthquake loading factor in accordance with AS1170.4:2007;
  - Subgrade preparation and earthworks requirements;
- Excavation methodologies, limitations and monitoring requirements, including monitoring of excavation induced vibrations;
- Excavation support requirements, including preliminary geotechnical design parameters for retaining walls and shoring systems;
- Approaches to limit potential impacts on adjacent structures, services and roads;
- Construction constraints including groundwater management requirements, if necessary; and
- The requirement for additional geotechnical investigations.

1.4 SCOPE OF WORKS

The scope of works for the PGI included:

- Review of available information from in-house sources;
- Preparation of appropriate health and safety plans;
- Review of relevant soil landscape and geological maps for the project area;
- Site walkover inspection by a Geotechnical Engineer to assess topographical features, condition of surrounding structures and site conditions;
- Dial Before You Dig (DBYD) services search and scan of proposed borehole locations for buried conductive services using a licensed service locator;
- Concrete coring through existing concrete hardstand at two borehole locations (BH1 & BH2);
- Drilling of one borehole (BH1) by a track-mounted drill rig and one borehole (BH2) by a ute-mounted drill rig using solid flight augers equipped with a 'tungsten-carbide' bit (T-C bit). BH1 was terminated at approximately 7.5 metres below ground level (mBGL), and BH2 reached T-C bit refusal at approximately 6.5 mBGL. Approximate borehole locations are shown in Figure 2;
- Standard Penetration Testing (SPT) during drilling of the boreholes at between 0.5 m and 1.5 m depth intervals to assess soil strength and collect soil samples for laboratory testing. Soil samples were sent to Macquarie Geotechnical Pty Ltd (Macquarie), a National Australian Testing Authority (NATA) accredited laboratory;
- Continuation of BH2 from T-C bit refusal, using NMLC coring techniques, to a termination depth of approximately 11.0 mBGL. Rock core recovered from the boreholes was logged, placed into core trays, photographed and delivered to Macquarie for testing and storage;
- Measurements of groundwater seepage/levels from boreholes during and immediately post drilling. No monitoring wells were installed as part of this investigation. Three monitoring wells installed from a previous investigation by others were measured during the field work;
- Backfilling of the boreholes with drilling spoil in the reverse order of excavation; and
- Preparation of this PGI report.

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

1.5 INVESTIGATION CONSTRAINTS

The PGI was limited by the preliminary intent of the investigation and the presence of structures at the site at the time of the investigation. The physical extent of the investigation was limited to an asphalt car park on the boundary with Cleveland Street, with no access available to the interior of the buildings for geotechnical purposes. The discussions and advice presented in this report are intended for the development of initial designs for the development. Further geotechnical investigations should be carried out before final design to confirm both the geotechnical and groundwater model, and the preliminary design parameters provided in this report.

2 SITE DESCRIPTION

2.1 SITE DESCRIPTION AND IDENTIFICATION

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

Table 2-1 Summary of Site Information

Information	Detail
Street Address	175 Cleveland Street, Redfern, NSW 2016
Lot and Deposited Plan (DP) Identification	Lot 15 in DP 57107, Lot 5 in DP 68798, Lot 1 in DP 724328, Lot 10 in DP 809537, Lots 3 and 4 in Section 2, DP 977379, and lot 1 in DP 1093304
Local Government Authority	Council of the City of Sydney
Parish	Alexandria
County	Cumberland
Current Zoning	MD – SEPP Major Development 2005 (Sydney Local Environment Plan, 2012)
Site Description	The site is irregular in shape. The site is currently occupied by a brick single-storey commercial warehouse, used as a furniture store and art workshop, and a second brick warehouse, used as a commercial printers. An irregular sloping asphalt car park is present at the corner of Cleveland Street and Woodburn Street. The car park is approximately 0.5 m higher than Woodburn Street. Paved surfaces at the site were in good condition. Cleveland Street is a Transport for NSW Roads and Maritime Services (RMS) asset.
Site Area	The site is approximately 1,060 m^2 (JPR, 2014)

2.2 LOCAL LAND USE

The site is situated within an area of high density residential and commercial use. Current uses on surrounding land are described in Table 2-3.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	Cleveland Street (an RMS asset), followed by a two-storey concrete commercial building and a five-storey brick apartment hotel.
East	Woodburn Street, followed by a four-storey brick youth hostel with a single-storey partially in-ground basement car park. Sydney Trains rail corridor lies beyond, 25 m from the site, orientated north-northwest between Redfern and Central Station.
South	A three-storey concrete residential building with a single-level partially in-ground basement car park, followed by two to three-storey brick residential buildings.

Direction Relative to Site	Land Use Description
West	Eveleigh Street, followed by a three to four-storey brick residential building. To the south-west is a construction site for a four-storey concrete residential building. No information was available regarding basements.

2.3 REGIONAL SETTING

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

Table 2-3 Topographic, Geological and Hydrogeological Information

Attribute	Description
Topography	The site is on the side slopes of a spur line which runs approximately southwest-northeast, following the alignment of the Sydney Trains railway corridor. Local topography slopes downwards to the northwest, at approximately 10°.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1991) indicates the site to be underlain by Ashfield Shale of the Wianamatta Group, which typically comprises of black to dark-grey shale and laminite. Ashfield Shale generally weathers into silty clay of medium to high plasticity. The site is close to the boundary of the Ashfield Shale, it is expected that Hawkesbury Sandstone may be present beneath the site at shallow depths. Outcrops of Quaternary aged Aeolian Sands (Botany Sands) are mapped approximately 90 m to the south-east of the site. Recent investigations in the area have indicated Aeolian Sands are present 50m to the south on Eveleigh Street. An infilled paleo channel (man made fill over alluvial soils) is present approximately 75 m to the north.
Soil Landscapes	The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 (2nd Edition) indicates that the residual landscape of the region of the site comprises the Blacktown Landscape. Soils are generally shallow to moderately deep (<100 cm) red and brown podzolic soils on crests, upper slopes and well-drained areas, and deep (150-300 cm) yellow podzolic soils and soloths on lower slopes and in areas of poor drainage. Land use is dominantly intensive residential and light and heavy industry. Soil Limitations include moderately reactive highly plastic subsoil, low soil fertility, and poor soil drainage.
Acid Sulfate Soils (ASS)	In accordance with the Sydney Local Environmental Plan 2012 Acid Sulfate Soils Map – Sheet ASS_009, the site does not fall within any category of Acid Sulfate Soils (ASS). For an unclassified site, works do not require development consent from council regarding ASS.

An online search was conducted using the NSW Office of Water (NOW) real-time database, which records relevant information pertaining to all licensed water bores for the state of New South Wales, revealed forty three (43) registered monitoring bore located within 500 km of the site. No standing water level data for the monitoring bores was recorded within the NOW database.

3 INVESTIGATION RESULTS

3.1 STRATIGRAPHY

For the development of a site-specific geotechnical model, the observed stratigraphy of shallow fill overlying a residual soil and weathered bedrock profile has been grouped into four geotechnical units. A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in Table 3-1.

More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in Appendix A. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted in the borehole logs are also presented in Appendix A.

Table 3-1 Summary of Inferred Subsurface Conditions

Unit	Material	Depth (mBGL) to Top of Unit [1]	Observed Thickness (m)	Material Description [1]	Comments
1	Fill	0	1.5 to 1.8	CONCRETE over mixed FILL	Asphalt up to 70 mm thick overlying Sand and Clayey and Gravelly Sand, with some ceramic and brick fill. Fill is inferred to be uncontrolled and poorly compacted. This area was formerly a brick building, with evidence of former brick footings on the boundary with Woodburn Street.
2	Residual Soil	1.5 to 1.8	0.7 to 3.0	Sandy CLAY	Generally medium plasticity firm to very stiff sandy clay. SPT N values range from 5 to 33 blows with hammer bouncing at the end of the second increment.
3	Extremely Weathered Shale	2.5 to 4.5	1.5 to 3.0	SHALE	Generally extremely weathered, extremely low to very low strength shale. SPT N values of refusal with hammer bouncing.
4	Distinctly Weathered Shale	5.5 to 6.0	11.3 [2]	SHALE	Generally distinctly weathered, very low to low strength shale. Where cored the bedding dips 0-5º, <1 mm thick. Defects within Unit 3 are generally closely spaced (~ 30-100 mm spacing) sub horizontal bedding partings, with one joint set (J1) dipping at 20-40° at 100-300mm spacing. Unit 3 is classified as Class IV Shale in accordance with Pells (2004).
5	Slightly Weathered Shale	6.8	N/A [3]	SHALE	Generally fresh, medium to high strength shale. Bedding dips 0-5º, <1 mm thick. Defects within Unit 4 are generally closely to moderately spaced (~ 100-300 mm spacing) sub horizontal bedding partings. There are two joint sets within Unit 4, one set (J1) dipping at 20-40° at 100-300mm spacing, increasing to >1m from 8.3mBGL. Joint set 2 (J2) is sub-vertical, typically irregular to curved, closed at depth, spacing typically >1m. Unit 4 is classified as Class III Shale in accordance with Pells (2004).

Notes:

1 Approximate depth below ground level at the time of our investigation. More detailed descriptions of subsurface conditions are available in the borehole logs in Appendix A. Depths may vary across the site.
2 Unit 4 was observed up to borehole termination depth in BH1.
3 Unit 5 was observed up to borehole termination depth in BH2.

3.2 GROUNDWATER OBSERVATIONS

Groundwater seepage was observed during the drilling of BH1 on 25 February 2015. No groundwater seepage was observed during the drilling of BH2. Groundwater measurements taken during drilling and from existing groundwater wells are presented in Table 3-2.

Table 3-2 Summary of Groundwater Seepage and Measurements

Borehole ID	Date of Observation	Depth to Groundwater (mBGL)	Tip Depth of well (mBGL)
BH1	25/02/2015	6.10 (inflow during drilling)	-
MW1	25/02/2015	2.40	7.00
MW2	25/02/2015	3.90	7.45
MW3	25/02/2015	4.23	7.15

Observed groundwater seepage levels may be affected by the low permeability of the encountered strata. Further groundwater monitoring should be undertaken prior to final design.

3.3 LABORATORY TEST RESULTS

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

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

A summary of soil test results is provided in Table 3-2.

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

Laboratory test certificates are presented in Appendix B

Table 3-3 Summary of Laboratory Test Results

Test/ Sample ID		BH1 (1.5-1.95 mBGL)	BH2 (4.5-4.95 mBGL)
Unit		Unit 2	Unit 2
Material Description [1]		Sandy CLAY	Sandy CLAY
Atterberg Limits	Liquid Limit (%)	31	38
	Plastic Limit (%)	16	22
	Plasticity Index (%)	15	16
Linear Shrinkage (%)		10.0	8.5
Moisture Content (%)		17.6	14.9
Soil Aggressivity	pH	6.4	5.3
	Electrical Conductivity (Ω.cm)	15,000	3,400
	Sulfate SO_4 (mg/kg)	240	82
	Chloride Cl (mg/kg)	20	<10

Notes:

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

4 PRELIMINARY GEOTECHNICAL DISCUSSIONS AND DESIGN ADVICE

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

- Excavation adjacent to Cleveland Street, an RMS asset.
- Basement excavatability.
- Basement excavation retention to prevent potential lateral deflections and ground loss as a result of excavations.
- Foundation design for building loads.

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

Table 4-1 Preliminary Geotechnical Discussions and Design Advice

	Preliminary Design [1]	Geotechnical Constraints [2]	Preliminary Discussions and Design Advice [2]	Preliminary Design Parameters [2]					
				Material [3]		Unit 1 Fill	Unit 2 Residual Soil	Unit 3 Extremely Weathered Shale	Unit 4 Distinctly Weathered Shale	Unit 5 Slightly Weathered Shale
				Typical Depth to Top of Unit (mBGL) [4]		0	1.5 to 1.8	2.5 to 4.5	5.5 to 6.0	6.8
				Bulk Unit Weight (kN/m³) [5]		16	19	21	24	24
				Elastic Modulus (MPa)		5	30	50	100	200
Basement Excavations and Earthworks	• Two levels of basement car parking. Excavation for the basement is expected to extend to a maximum depth of approximately 9 mBGL along Cleveland Street.	• Proposed excavation will likely encounter Unit 1, 2, 3, 4 and 5 material.	• Temporary batters may be considered for retention of material encountered during basement excavation where site constraints allow. • Batters given for rock units may only be used with consideration of rock support systems such as pattern bolting, spot bolting or shotcreting based upon the rock mass characteristics encountered during excavation. Inspection during construction by an experienced geotechnical engineer or engineering geologist will be required to determine temporary and permanent rock support requirements. Permanent batters may require surface protection to prevent erosion and slaking • Where excavations extend beneath the zone of influence of nearby structures/ services/ pavements basement retention will be required. • Units 1, 2 and 3 should be diggable with a 20t Hydraulic Excavator. Unit 4 should be easy ripping with a D6 or similar. Unit 5 will be hard ripping with a D8 dozer or equivalent. • All earthworks should be carried out in accordance with AS3798: 2007. This standard applies to any site filling undertaken and to the preparation of basement slab subgrades.	Batter Angle [6]	Temporary [6]	N/A	1.5H:1V	1.5H:1V	Vertical with Rock Support	Vertical with Rock Support
					Permanent [6]	N/A	2H:1V	2H:1V	Vertical with Rock Support	Vertical with Rock Support
Excavation Retention and Rock Face Support			• Cantilevered retaining walls are typically the most economically viable retention method up to 5 m height. Anchored walls may be more economically viable above 5 m height and may be required to limit lateral deflections where retention systems are within the zone of influence of nearby structures/ services/ pavements. • Rock face protection of Unit 4 and 5 material using shotcrete and drainage systems will be required. • Consideration will need to be given to excavation retention in competent rock and should be given to the potential for stress relief movement of excavation faces in the design of the basement retention system. Further discussion of this is given in Section 4.1. • Consideration will need to be given to monitoring lateral and vertical deflections of retained soil and to monitoring construction induced vibrations. Further discussion of this is given in Section 4.2. • Parameters given in this table for design of deep foundations may be used for design of basement retention systems.	Earth Pressure Coefficients	At rest, K_o [7]	0.66	0.58	0.58	-	-
					Passive, K_p [7]	2.04	2.46	2.46	1000 kPa Ultimate stress block	2000 kPa Ultimate stress block
					Active, K_a [7]	0.49	0.41	0.41	-	-
Foundations	• Eight-storey building over two levels of basement parking. • Proposed basement plan extents to all site boundaries	• Final excavation levels likely to be in Unit 5 material.	Footing Foundations • All footings should found below Unit 1 materials to avoid the potential of potentially large settlements caused by founding in these low density materials. • Footings and slabs on Unit 5 – Slightly Weathered Shale should be designed in accordance with AS2870:2011 based on a Site Classification of 'A.'. • Consideration must be given to the possibility of differential settlement caused by foundations for a structure spanning the interface of differing materials. Further discussion of this is given is Section 4.3.	Preliminary Allowable Bearing Pressure (kPa) [8]		NA	250	500	1000	2000
				Undrained shear strength, c_u (kPa)		-	100	-	-	-
				Drained friction angle, ϕ' (°)		20	25	-	-	-
				Drained cohesion, c' (kPa)		0	5	-	-	-

	Preliminary Design [1]	Geotechnical Constraints [2]	Preliminary Discussions and Design Advice [2]	Preliminary Design Parameters [2]					
				Material [3]		Unit 1 Fill	Unit 2 Residual Soil	Unit 3 Extremely Weathered Shale	Unit 4 Distinctly Weathered Shale	Unit 5 Slightly Weathered Shale
				Typical Depth to Top of Unit (mBGL) [4]		0	1.5 to 1.8	2.5 to 4.5	5.5 to 6.0	6.8
				Bulk Unit Weight (kN/m³) [5]		16	19	21	24	24
				Elastic Modulus (MPa)		5	30	50	100	200
			Pile Foundations • Pile foundations may be considered where high lateral or axial loads are to be supported. • The parameters given may also be used for design of retention support. • We recommend that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.40 is used for the preliminary design of piled support in accordance with AS 2159:2009 based upon the preliminary nature of the soil parameters given. The GSRF may be increased upon finalising the development details and subject to further assessments having been carried out e.g. pile testing during construction.	Ultimate Vertical End Bearing Pressure (kPa) [9, 11]		N/A	750	1500	3000	6000
				Ultimate Shaft Adhesion (kPa) [10, 11]	in Compression	15	45	75	150	350
					in Uplift	5	15	37.5	75	175
				Susceptibility to Liquefaction during an Earthquake [12]		Medium	Low	Low	Low	Low
Groundwater Management	• Two levels of basement car parking. Excavation for the basement is expected to extend to a maximum depth of approximately 9.0 mBGL.	• Groundwater levels were observed during the investigation at approximately 2.4 to 4.2 mBGL.	• Groundwater is expected to be encountered within the basement excavations. Although the intact rock mass permeability of the Ashfield formation is generally low, groundwater flows may be moderate to high from fractured zones within the rock mass. Groundwater management options may include the grouting of water bearing fractures during excavation or the installation of drainage systems behind the excavation retention facing. • Surface water seepage into these excavations may occur during and following periods of rainfall. Surface water should be controlled by diverting overland flows away from excavations and may be managed by conventional sump and pump methods.							
Earthquake Site Risk Classification			• AS 1170.4:2007 indicates an earthquake subsoil class of Class C_e (Shallow Soil). • AS 1170.4:2007 indicates that the hazard factor (z) for Sydney is 0.08.							
Soil and Groundwater Aggressivity	• Proposed structure will incorporate buried concrete and steel elements.	• Low permeability soils above and below the groundwater table. • AS2159:2009 gives guidelines for foundation susceptibility to soil and groundwater aggressivity.	• Analysis of the pH, chloride and sulfate content and electrical conductivity of the soil was compared with criteria in AS 2159:2009, providing the following exposure classifications: o 'Mild' for buried concrete structural elements; and o 'Non-aggressive' for buried steel structural elements.							

Notes:

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

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

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

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

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

6 Batter angles recommended are based upon ground conditions encountered in the borehole locations only. Ground conditions may vary and preliminary batter angles should be confirmed by additional geotechnical investigations and inspections during construction by an experienced geotechnical engineer. Batter angles provided assume an overall batter height of less than 5 m. Should batters extend beyond 5 m, batter designs should be carried out by an experienced geotechnical engineer and may need to incorporate benches.

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

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

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

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

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

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

4.1 EXCAVATION RETENTION

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

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

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

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

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

4.1.1 Rock Support

An allowance should be made for support of vertical excavation faces in Unit 3 and better material, including rock bolts, rock anchors and/ or shotcrete (mesh reinforced) to support weak seams, fracture zones and isolated individual blocks of rock. Specific support requirements can only be assessed during excavation. An experienced Engineering Geologist or Geotechnical Engineer should carry out regular inspections as excavation progresses (at least every 1.5 m depth of excavation).

Rock bolts, and anchors should they be required, should generally be specified in terms of performance requirements and constructed by contractors experienced in ground anchor technology.

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

4.1.2 Construction Considerations for Deep Excavations

As the basement excavation will likely extend through both materials which require full retention (Units 1, and 2) and material which will require rock face support (Unit 3 and better), particular consideration must be given to the integration of retention and support designs at the site. The following methodologies could be considered for design of retention/ support systems:

- Full Height Retention – Soldier pile walls to continue the full depth of basement excavation with a socket in Unit 4 below bulk excavation level. This option would allow excavation to continue through the full depth of excavation without concern of disturbing the rock on which the piles are founded. Boring of piles within the medium to high strength rock will likely be slow and cause machine wear; or
- Part Retention – Construction of a part-retention system may proceed as follows:
    - Units 1, 2 are to be retained as described above, socketed into Unit 3 – Distinctly Weathered Shale.
    - Excavation to the top of Unit 3 material.
    - Anchors to be installed near the base of the retaining wall, socketed into Unit 3.
    - Excavation could then proceed into Unit 3. Spot bolting beneath the toe of the retaining wall may be required to limit block failure from the wall foundation.
    - Further bolting and mesh reinforced shotcrete support of Unit 4 as required, as discussed in Section 4.1.1.

Should the proposed structure found on the retaining wall, consideration should be given in the wall design to the suitability of the rock beneath the pile toe as foundation and ability to support additional building loads. We recommend that further investigations, modelling of the rock conditions, and site inspections are carried out to assess rock support requirements below the pile toe.

4.1.3 Excavation Interaction with Neighbouring Structures and Basements

Medium rise structures and potential basements of unknown extent were noted on adjoining properties as part of the development. Surrounding footings and excavation faces of these developments will lie within the zone of influence of the proposed excavation. There is the potential for neighbouring structures to be adversely affected.

The design of excavation support should consider loading from neighbouring structures and the requirement for underpinning where excavations in rock extend below adjacent building foundation levels.

Detailed survey of the relative positions, levels and working loading of neighbouring basements and footings should be acquired prior to final design. The detailed survey should be used to accurately model the interaction of the proposed development with existing structures in the vicinity of the site using finite element software.

4.2 Basement Excavation Monitoring

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

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

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

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations/ services/ pavements and other structures located within or near the zone of influence of the excavation. Owners of existing services at the site should be consulted to assess appropriate deflection limits for their infrastructure. Along Cleveland Street it would be

expected that RMS will require a minimum of two inclinometer installations and level monitoring points should excavations exceed 6 m depth. Measurements should be taken:

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

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

An ongoing monitoring programme will not be required if the contractor can verify, based on trials carried out at the commencement of the works and with the agreement of a Geotechnical Engineer, that the ppv will not exceed set limits. However, should equipment used during excavation and construction works vary from that used during the trial or as agreed, further vibrations assessments by a Geotechnical Engineer, and/ or an ongoing monitoring programme, may be required.

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

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

4.2.1 Construction Vibration Mitigation

As a guide, safe working distances for typical items of vibration intensive plant are listed in Table 4-2. The safe working distances are quoted for both "cosmetic" damage (refer British Standard BS 7385:1993) and human comfort (refer NSW Environmental Protection Agency Vibration Guideline).The safe working distances should be complied with at all times, unless otherwise mitigated to the satisfaction of the relevant stakeholders.

Table 4-2 Recommended Safe Working Distances for Vibration Intensive Plant

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385:1993) [1]	Human Response (EPA Vibration Guideline)
Vibratory Roller	< 50 kN (typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (typically 2-4 tonnes)	6 m	20 m
	< 200 kN (typically 4-6 tonnes)	12 m	40 m
	< 300 kN (typically 7-13 tonnes)	15 m	100 m
	< 300 kN (typically 13-18 tonnes)	20 m	100 m

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385:1993) [1]	Human Response (EPA Vibration Guideline)
	< 300 kN (typically >18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18 t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Notes:
1 More stringent conditions may apply to heritage buildings or other sensitive structures.

In relation to human comfort (response), the safe working distances in Table 4-2 relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted, as discussed in British Standard BS 6472-1:2008.

The safe working distances provided in Table 4-2 are given for guidance only. The values obtained from these codes are general in nature and site specific values by detailed acoustic assessment of the rock mass should be obtained.

4.3 FOUNDATIONS

Should footings for the proposed development span the interface of several materials identified in this investigation, variable ground conditions may cause difficulties for subgrade preparation. Selection of footing types and founding depth will need to consider the risk of adverse differential ground movements within the foundation footprint and between high level and deeper footings. Unless an allowance for such movement is included in the design of the proposed development, we recommend that all new structures found on natural materials with comparable end bearing capacities. Possible features designed to accommodate potential differential movement of the structures may include movement joints, dowelled connections or shear keys.

4.4 CONSTRUCTION CONSIDERATIONS FOR THE ASHFIELD SHALE FORMATION

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

5 CONCLUSIONS

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

- Excavation adjacent to Cleveland Street, an RMS asset.
- Basement excavatability.
- Basement excavation retention to prevent potential lateral deflections and ground loss as a result of excavations.

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

6 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

The adopted investigation scope was limited by the investigation intent and by the presence of structures at the site during the investigation. This PGI report will need to be supplemented with additional cored boreholes given the scale of the proposed development.

Further geotechnical investigations should be carried out to confirm the results and address any limitations prior to adoption of the recommendations of this report for detailed design. These investigations should be carried out once preliminary design and construction details are available and should include:

For Design Phase

- For the design of the excavation adjacent to Cleveland Road consider the guidance and additional investigation requirement given in RMS technical directive GTD2012/001 – Excavations adjacent to RMS Infrastructure.
- The rock classifications for material encountered at foundation level may be improved on the basis of consistent rock quality encountered in additional boreholes. Should higher bearing pressures be required for foundation design, at least three additional deep cored boreholes to 5 m below foundation level should be drilled to confirm the quality of Shale in Table 4-1.
- Ongoing monitoring of existing groundwater monitoring wells should be undertaken to determine hydrogeological conditions.
- Stress-strain dependent analysis of basement retention systems should be undertaken for final design to determine expected deflections and interaction with adjacent structures.
- All excavated material transported off site should be classified in accordance with NSW EPA 2014 - Waste Classification Guideline Part 1; Classifying Waste.

For Construction Phase

- Dilapidation surveys should be carried out on existing structures that may be impacted by any proposed excavations, particularly where located within the zone of influence of excavations. These surveys should be carried out by a qualified structural engineer and/or geotechnical engineer prior to and following completion of construction works.
- Working platforms for construction plant, placed on in-situ materials or on engineered fill, should be designed by an experienced and qualified geotechnical engineer.
- A suitably qualified geotechnical engineer is to assess the condition of exposed material at foundation or subgrade level to assess the ability of the prepared surface to act as a foundation or as a subgrade.
- Ongoing monitoring of ground vibrations, settlements and lateral movements in conjunction with survey results should be carried out during basement excavation.
- Regular inspections of battered and unsupported excavations where localised excavations are proposed, to confirm inferred geotechnical conditions, to assess the suitability of design assumptions and to provide further advice with regards to excavation retention/ support and proposed construction methodologies, if required.

7 STATEMENT OF LIMITATIONS

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

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

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

8 REFERENCES

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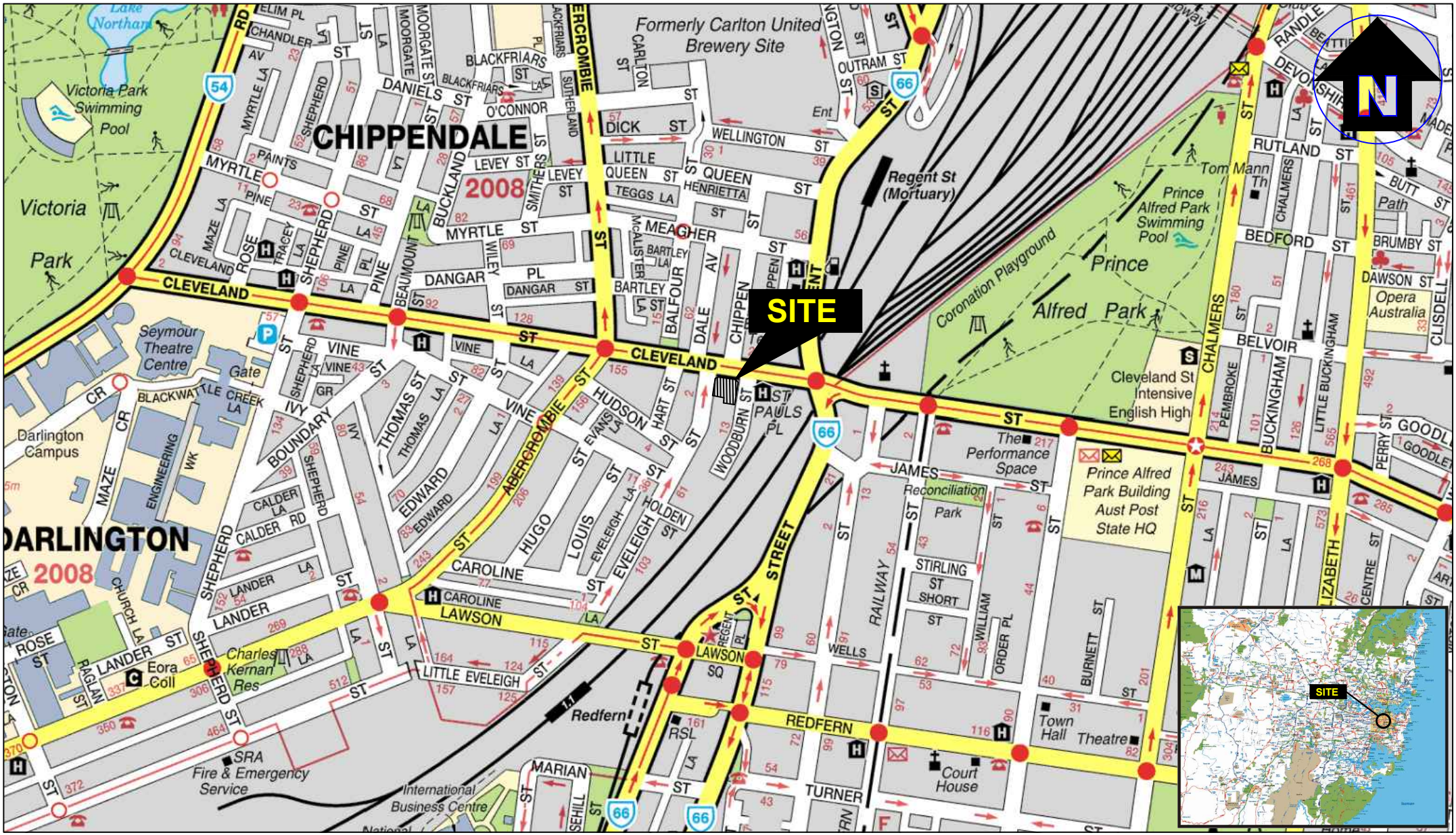
9 ABBREVIATIONS

AHD	Australian Height Datum
BGL	Below Ground Level
BH	Borehole
DP	Deposited Plan
EI	Environmental Investigations
EPA	NSW Environmental Protection Agency
NATA	National Association of Testing Authorities, Australia
NOW	NSW Department of Primary Industries, Office of Water
PGI	Preliminary Geotechnical Investigation
RMS	NSW Roads and Maritime Services

FIGURES

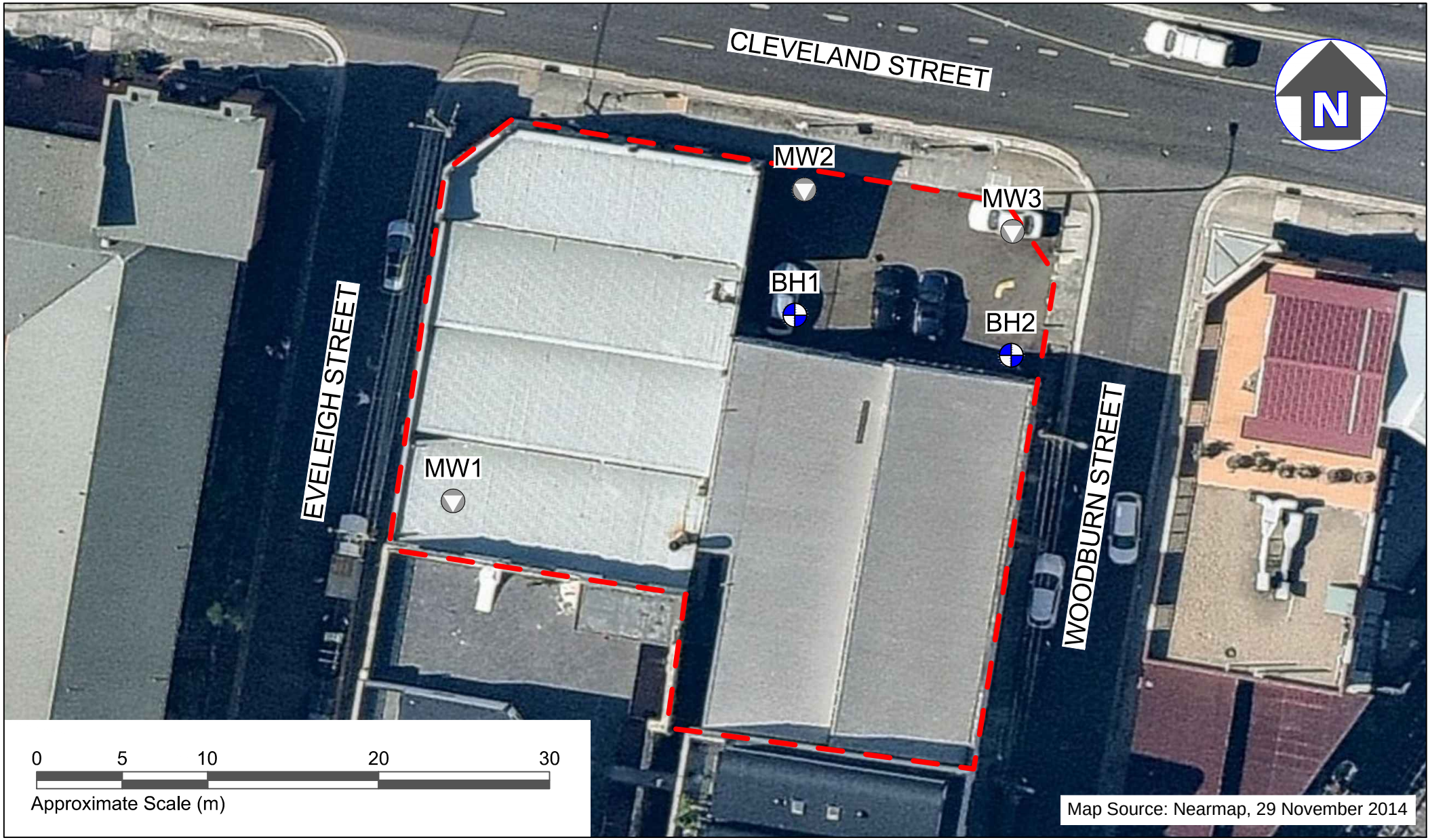


Environmental Investigations Australia Contamination | Remediation | Geotechnical Suite 6.01, 55 Miller Street, PYRMONT 2009 Ph (02) 9516 0722 Fax (02) 9518 5088	Drawn:	SK	**Platinum Restaurant Group** Preliminary Geotechnical Investigation 175 Cleveland Street, Redfern, NSW Site Locality Plan
	Approved:	RP	
	Date:	16/3/15	
	Approx Scale:	1:11750	

Figure:

1

Project: E22434 GA



LEGEND

- Approximate Borehole Location (EI, 2015)
- Approximate Existing Borehole/Monitoring Well Location
- Approximate Site Boundary

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Drawn:	SK
Approved:	RP
Date:	16/3/15
Approx Scale:	1:300 @ A4

Platinum Restaurant Group
Preliminary Geotechnical Investigation
175 Cleveland Street, Redfern, NSW
Borehole Location Plan

Figure: 2

Project: E22434 GA

APPENDIX A

BOREHOLE LOG REPORTS AND EXPLANATORY NOTES

BOREHOLE: BH1

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

Project	New Mixed-use Development			Sheet	1 OF 1
Location	175 Cleveland Street, Redfern, NSW	East	333588.1 m	Date Started	25/2/15
Position	Refer to Figure 2	North	6248688.1 m MGA94 Zone 56	Date Completed	25/2/15
Job No.	E22434	Contractor	Traccess Drilling Pty Ltd	Logged SK	Date: 25/2/15
Client	Platinum Restaurant Group	Drill Rig	MultiDrill 4000	Checked RP	Date: 16/3/15
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	F		0					-	FILL: ASPHALT; 70 mm.	-		ROAD SURFACE
								-	FILL: Gravelly SAND; fine to medium grained, black, gravel is fine to coarse, subangular bluestone and brick gravel, trace ceramics.			FILL
	E-F				SPT 0.50-0.95 m 2,2,2 N=4 BH1_0.5-0.95						-	
				1.50								
			2		SPT 1.50-1.95 m 1,2,3 N=5 BH1_1.5-1.95			Cl	Sandy CLAY; medium plasticity, pale brown to brown, sand is fine grained.			RESIDUAL SOIL
				2.50					From 2.5 m, grey mottled red, no sand.		F	
	E				SPT 3.00-3.45 m 5,8,10 N=18 BH1_3.0-3.45					D		
			4								VSt	
				4.50								
	F		6		SPT 4.50-4.95 m 5,20,20 N=40 BH1_4.5-4.95			-	SHALE; red brown, inferred extremely low strength, inferred extremely weathered.			WEATHERED ROCK
				5.50					From 5.5 m, dark brown.			
				6.00					From 6.0 m, extremely low to very low strength.		-	
					SPT 6.00-6.10 m 10 HB BH1_6.0-6.10							
				7.00					From 7.0 m, dark grey.	W		
				7.50								
			8						Hole Terminated at 7.50 m Terminated due to rig failure. Backfilled with drilling spoil and concrete capped.			
			10									
			12									

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

BOREHOLE: BH2

Environmental Investigations Australia
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Project	New Mixed-use Development			Sheet	1 OF 2
Location	175 Cleveland Street, Redfern, NSW	East	333601.2 m	Date Started	6/3/15
Position	Refer to Figure 2	North	6248686.7 m MGA94 Zone 56	Date Completed	6/3/15
Job No.	E22434	Contractor	Terratest Pty Ltd	Logged SK	Date: 6/3/15
Client	Platinum Restaurant Group	Drill Rig	MCT-200	Checked RP	Date: 16/3/15
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	F	GWNE	0					-	FILL: ASPHALT; 50 mm.	-		ROAD SURFACE
								-	FILL: SAND; medium to coarse grained, brown, with some fine to coarse, subrounded gravel.	D		FILL
				0.50	SPT 0.50-0.95 m 5,3,2 N=5 BH2_0.5-0.95			-	FILL: Clayey SAND; fine to medium grained, grey to brown, clay is of high plasticity, trace ceramics.		-	
	E									D - M		
				1.60	SPT 1.50-1.95 m 0,0,1 N=1 BH2_1.5-1.80 BH2_1.8-1.95 PP =225-255 kPa				From 1.60 to 1.65 m, with some ash.			
				1.80				Cl	Sandy CLAY; medium plasticity, grey mottled red, sand is fine to medium grained.	D	VSt	RESIDUAL SOIL
			2	2.50				-	SHALE; grey, inferred extremely low to very low strength, inferred extremely weathered.			WEATHERED ROCK
					SPT 3.00-3.45 m 8,16,17 HB N=33 BH2_3.0-3.45							
	F		4							-	-	
					SPT 4.50-4.95 m 6,14,18 HB N=32 BH2_4.5-4.95							
				5.50					From 5.5 m, inferred very low to low strength, inferred distinctly weathered.			ROCK
	H		6		SPT 6.00-6.13 m 10 HB BH2_6.0-6.13							
				6.50					Continued as Cored Borehole			
			8									
			10									
			12									

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

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BOREHOLE: BH2

Project	New Mixed-use Development				
Location	175 Cleveland Street, Redfern, NSW	East	333601.2 m	Sheet	2 OF 2
Position	Refer to Figure 2	North	6248686.7 m MGA94 Zone 56	Date Started	6/3/15
Job No.	E22434	Contractor	Terratest Pty Ltd	Date Completed	6/3/15
Client	Platinum Restaurant Group	Drill Rig	MCT-200	Logged SK	Date: 6/3/15
		Inclination	-90°	Checked RP	Date: 16/3/15

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	80-90% RETURN	100	50 (67)	0							
				2							
				4							
				6							
					6.50		Continuation from non-cored borehole				
					6.80		SHALE; dark grey, returned as stiff to very stiff, high plasticity sandy clay.	XW - DW		6.63-6.68: BPx2 0° PR S CN	
							SHALE; bedding dipping 0-5 degrees, <1 mm thick, dark grey.	SW		6.84: JT 20° ST RF Fe SN 6.90-7.02: BPx6 0 - 5° PR RF Fe SN avg sp = 5-30 mm 7.03-7.06: JT 45° PR RF Fe SN 7.06-7.09: JT 50° PR RF Fe SN 7.19: BP 0° PR S CN 7.23: JT 5 - 20° UN RF Fe SN 7.24-7.32: JT 60° IR RF Fe SN 7.27-7.30: JT 60° PR RF Fe SN 7.34: BP 0° PR RF Fe SN 7.34-7.35: JT 20° PR RF Fe SN 7.36-7.40: JT 0 - 80° IR RF CN 7.42-7.44: JT 30° PR RF CN 7.50-7.57: BPx3 0 - 10° PR RF Fe SN avg sp = 20-30 mm 7.50-7.67: JT 60° PR RF Fe SN 7.61-7.64: DB 7.64-7.70: JT 60° PR RF CN 7.75-7.77: JT 30° PR RF CN 7.89: BP 0° PR RF CN 7.98-8.00: CS 20 mm, f-m, wedged 8.13: BP 5° PR RF CN 8.21: BP 5° PR RF CN 8.30-8.34: JTx2 30 - 40° PR RF CN 8.76: BP 0° PR RF CN 8.97: HB 9.00: HB 9.08: HB 9.39: BPx2 0° PR RF CN 9.43: JT 10° PR RF CN 9.43-9.63: JT 80° closed 9.53: BP 0° PR RF CN	
				8							
		100	77 (76)	10	11.00			FR			
							Hole Terminated at 11.00 m Target Depth Reached. Backfilled with drilling spoil and concrete capped.			9.69-9.77: JT 60° closed 9.78-9.81: JT 40° PR RF CN 9.97-10.05: CS 70 mm, f-c, a 10.33: BP 0° PR RF CN 10.54-10.57: JT 35° PR RF CN 10.78: BP 0° PR RF CN 10.90: BP 0° PR RF CN	
				12							

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

REPORT OF BOREHOLE: BH2

Project: New Mixed-use Development
Location: 175 Cleveland Street, Redfern, NSW
Position: Refer to Figure 2
Job No. : E22434
Client: Platinum Restaurant Group

East: 333601.2 m
North: 6248686.7 m MGA94 Zone 56
Inclination: -90°
Box: 1 of 1
Hole Depth: 11.00 m

Depth Range: 6.50 m to 11.00 m
Contractor: Terratest Pty Ltd
Drill Rig: MCT-200
LOGGED: SK DATE: 6/3/2015
CHECKED:RP DATE: 16/3/2015

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

DRILLING/EXCAVATION METHOD

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

PENETRATION/EXCAVATION RESISTANCE

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

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

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

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

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

WATER

Water level at date shown

Water inflow

Partial water loss

Complete water loss

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

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

SAMPLING AND TESTING

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

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

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

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

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

SCR = Solid Core Recovery (%)

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

RQD = Rock Quality Designation (%)

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

MATERIAL BOUNDARIES

———— = inferred boundary

- - - - - - - - = probable boundary

— ?— ?— ?— ? = possible boundary

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METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

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

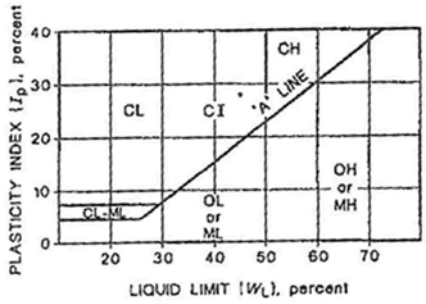
CLASSIFICATION AND INFERRED STRATIGRAPHY

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

PARTICLE SIZE CHARACTERISTICS

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

PLASTICITY PROPERTIES



USCS SYMBOLS

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

MOISTURE CONDITION

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

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

CONSISTENCY

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

DENSITY

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

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

MINOR COMPONENTS

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

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TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

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

STRENGTH

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

 # Rock Strength Test Results

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

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

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

ROCK MATERIAL WEATHERING

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

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ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

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

ROCK MATERIAL DESCRIPTION

Layering

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

Structure

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

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

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

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

DEFECT APERTURE

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

APPENDIX B

LABORATORY TEST CERTIFICATES

POINT LOAD STRENGTH INDEX REPORT

AS4133 4.1

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street Pyrmont NSW 2009	**Storage History:**	Core Boxes
Project:	175 Cleveland Street, Redfern (E22434)	**Report No:**	S2439-PLT
Job No:	S15056	**Date Tested:**	13/03/2015

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

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Sample Number	Borehole ID	Depth (m)	Sample Description	Test Type	Average Width (mm)	Platen Seperation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S2439	BH2	6.50-6.60	Sandstone	Diametral	-	50.0	0.11	0.04	0.04	
				Axial	50.0	43.0	0.10	0.04	0.04	
S2440	BH2	7.10-7.20	Siltstone	Diametral	-	52.0	0.25	0.09	0.09	
				Axial	52.0	47.0	1.48	0.47	0.50	
S2441	BH2	8.20-8.30	Siltstone	Diametral	-	52.0	0.25	0.09	0.09	
				Axial	52.0	38.0	0.85	0.34	0.34	
S2442	BH2	9.30-9.40	Siltstone	Diametral	-	52.0	0.05	0.02	0.02	
				Axial	52.0	42.0	0.64	0.23	0.24	

Comments:

Authorised Signatory:

16/03/2015

NATA Accredited Laboratory Number: 14874

Chris Lloyd

Date:

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

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

SOIL CLASSIFICATION REPORT

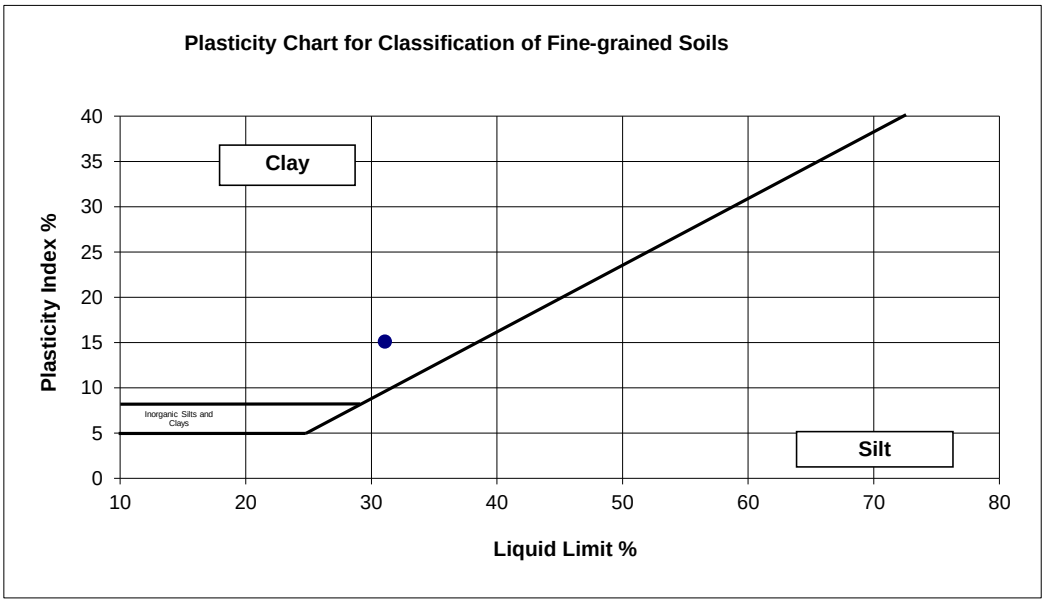
Client:	Environmental Investigations	**Source:**	BH1 1.50-1.95m
Address:	Suite 6.01, 55 Miller Street Pyrmont NSW 2009	**Sample Description:**	sandy CLAY
Project:	175 Cleveland Street, Redfern (E22434)	**Report No:**	S2437-PI
Job No:	S15056	**Lab No:**	S2437

Test Procedure:

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

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

Liquid Limit (%):	31	**Linear Shrinkage (%):**	10.0
Plastic Limit (%):	16	**Field Moisture Content (%):**	17.6
Plastic Index:	15		



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

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

16/03/2015

Date:

MACQUARIE GEOTECH

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

Facility

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CLASSIFICATION REPORT

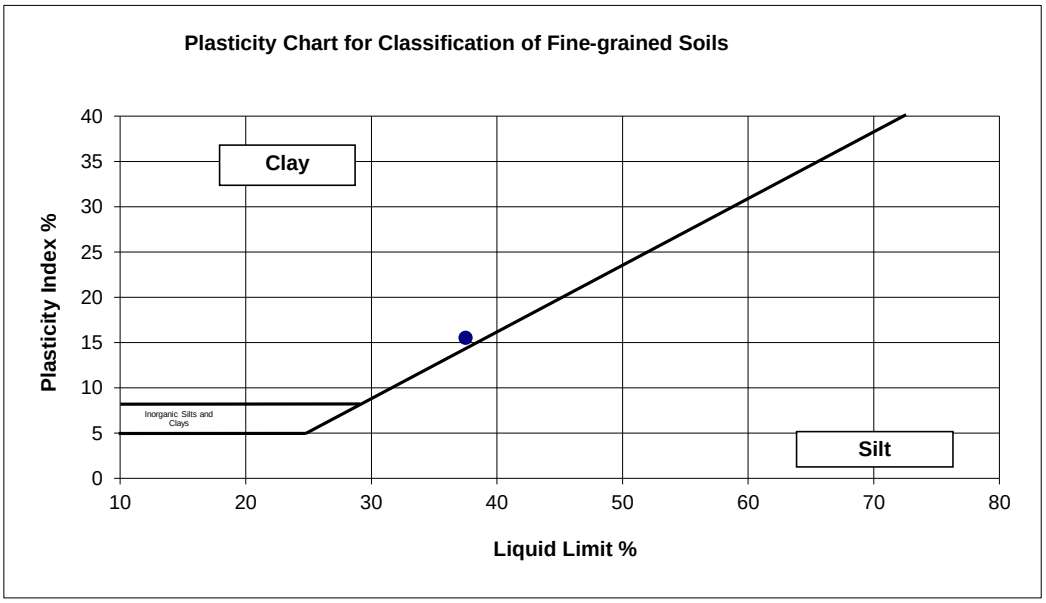
Client:	Environmental Investigations	**Source:**	BH2 4.50-4.95m
Address:	Suite 6.01, 55 Miller Street Pyrmont NSW 2009	**Sample Description:**	sandy CLAY
Project:	175 Cleveland Street, Redfern (E22434)	**Report No:**	S2438-PI
Job No:	S15056	**Lab No:**	S2438

Test Procedure:

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

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

Liquid Limit (%):	38	**Linear Shrinkage (%):**	8.5
Plastic Limit (%):	22	**Field Moisture Content (%):**	14.9
Plastic Index:	16		



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

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

16/03/2015

Date:

MACQUARIE GEOTECH

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

Facility

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 124935

Client:
Macquarie Geotech
3 Watt Dr
Bathurst
NSW 2795

Attention: Chris Lloyd

Sample log in details:

Your Reference:	**S15056, Refern**		
No. of samples:	2 soils		
Date samples received / completed instructions received	11/03/15	/	11/03/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	18/03/15	/	13/03/15
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Misc Inorg - Soil			
Our Reference:	UNITS	124935-1	124935-2
Your Reference	----------	S2437	S2438
Depth	----------	1.5-1.95	4.5-4.95
Type of sample		Soil	Soil
Sample ID		BH3	BH2
Date prepared	-	12/03/2015	12/03/2015
Date analysed	-	12/03/2015	12/03/2015
pH 1:5 soil:water	pH Units	6.4	5.3
Chloride, Cl 1:5 soil:water	mg/kg	20	<10
Sulphate, SO4 1:5 soil:water	mg/kg	240	82
Resistivity in soil*	ohm m	150	34

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			12/03/2015	124935-1	12/03/2015 || 12/03/2015	LCS-1	12/03/2015
Date analysed	-			12/03/2015	124935-1	12/03/2015 || 12/03/2015	LCS-1	12/03/2015
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	124935-1	6.4 || 6.4 || RPD: 0	LCS-1	102%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	124935-1	20 || 20 || RPD: 0	LCS-1	103%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	124935-1	240 || 260 || RPD: 8	LCS-1	115%
Resistivity in soil*	ohm m	1	Inorg-002	<1.0	124935-1	150 || 160 || RPD: 6	[NR]	[NR]

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

APPENDIX C

IMPORTANT INFORMATION

Important Information

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

SCOPE OF SERVICES

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

RELIANCE ON DATA

EI has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. EI has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, EI will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to EI.

GEOTECHNICAL ENGINEERING

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

LIMITATIONS OF SITE INVESTIGATION

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

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

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

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

VERIFICATION OF SITE CONDITIONS

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

REPRODUCTION OF REPORTS

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

REPORT FOR BENEFIT OF CLIENT

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

OTHER LIMITATIONS

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