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GEOTECHNICAL INVESTIGATION REPORT

11-19 FRENCHMANS ROAD, RANDWICK NSW 2031

PREPARED FOR FRENCHMANS LODGE PROPERTIES PTY LTD

CES DOCUMENT REFERENCE: CES190901-FRE-AC

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1 INTRODUCTION

Consulting Earth Scientists Pty Ltd (CES) was commissioned by Frenchmans Lodge Properties Pty Ltd (the Client) to undertake a geotechnical investigation for a proposed Summitcare Aged Care building at 11-19 Frenchmans Road, Randwick NSW 2031, herein referred to as the Site.

Following the demolition of existing aged care facility structures, we understand that it is proposed to develop the Site by the construction of a new Summitcare Aged Care building, which is a proposed three (3) storey building with a one-level basement carpark constructed between 3 m to 4 m below the existing Site grade.

The purpose of the geotechnical investigation was to assess the subsurface ground conditions at the Site and provide information and recommendations in relation to the following:

- An assessment of the engineering properties of the materials encountered;
- Site classification in accordance with Australian Standard (AS) 2870-2011, *Residential slabs and footings*;
- Site and subgrade preparation;
- An assessment of soil/rock aggressivity to buried concrete and steel;
- Excavation conditions and support, including:
    - Excavatability;
    - Permanent and temporary batter slopes;
    - Shoring systems and design parameters; and
    - Support and retention requirements.
- Groundwater depth and issues, including infiltration rates in accordance with British Standard (BS) 5930-2015, *The code of practice for ground investigations*;
- The results of geotechnical laboratory testing;

- Foundations, including:
    - Footing systems;
    - Allowable and ultimate bearing pressures; and
    - Likely settlements.
- Pavement and floor slabs, including:
    - Design parameters (CBR and Modulus of subgrade reaction); and
    - Subgrade preparation
- Geotechnical constraints identified during the Site investigation

The scope of works covered in this report has been undertaken in accordance with CES proposal (Document Reference: CES190901-FRE-AA) dated 24 October 2019. This report was prepared concurrently with and should be read in conjunction with the environmental Preliminary Site Investigation (PSI) report prepared by CES (Document Reference: CES190901-FRE-AB, dated 25 November 2019).

2 SITE INFORMATION

2.1 SITE LOCATION AND SITE DESCRIPTION

The Site is located at 11-19 Frenchmans Road, Randwick NSW 2031, within the Randwick City Council Local Government Area (LGA) and comprises three lots, identified as Lot 3 and 4 in DP 13779 and Lot 10 DP 845575. The Site covers an area of approximately 2,715 m^2, the location of the Site is shown in Figure 1.

At the time of this investigation, the Site consisted of an operational aged care facility that included a large two-storey brick building that covered more than half of the property, a two-storey brick office building, a second smaller brick building and two, two-storey residential buildings.

The Site surface outside of the building footprints was observed to generally be covered with hard standing with the exception of small landscaped areas in peripheral areas. The ground surface was assessed to slope to the northwest by typically less than 3%.

Existing developments on adjoining land include the adjacent roads of Frenchmans Road and McLennan Avenue to the south and north, and residential buildings to the east and west.

2.2 REGIONAL GEOLOGY

A review of the Sydney 1:100 000 Sheet 9130, 1st edition. Geological Survey of New South Wales, Sydney geological map indicates that the Site is positioned near a mapped boundary separating two geological units defined by: (1) Triassic medium to coarse grained quartz sandstone with very minor shale and laminate lenses of the Hawkesbury Sandstone Group, and (2) Quaternary medium to fine-grained marine sand with podsols.

2.3 ACID SULFATE SOILS

With reference to the Botany Bay Acid Sulfate Soils Risk Map, Edition 2, 1:25,000 (Department of Land and Water Conservation, 1997), the site is situated in an area of no known occurrence of acid sulfate soils and the Randwick City Council LEP 2012 indicates that the Site is not situated on land classified at risk from Acid Sulfate Soils.

3 FIELDWORK PROGRAMME

3.1 EXPLORATORY HOLES

The fieldwork was carried out on 6 and 7 November 2019. The geotechnical investigation comprised the drilling of three (3) boreholes and one (1) test pit completed as part of the joint environmental and geotechnical fieldwork programme. The drilling was undertaken by a specialist drilling subcontractor (Hagstrom Drilling Pty Ltd) using a Geoprobe 205, track mounted drilling rig.

A Geotechnical Engineer from CES was present full-time on site during the fieldwork programme to observe testing and log the samples recovered from the investigation holes. The samples were logged in accordance with AS 1726-2017, *Geotechnical site investigations*. The CES Geotechnical Engineer also recorded groundwater observations and collected representative samples.

Selected samples were dispatched to a NATA accredited geotechnical laboratory for testing. Further information on Site observations and sample locations pertinent to the PSI are provided in the PSI report (CES Document Reference: CES190901-FRE-AB, dated 25 November 2019).

Due to site access constraints, a fourth borehole planned near McLennan Avenue was not able to be drilled. The boreholes and test pit locations and termination depths are summarised in Table 1, the borehole and test pit locations were determined using a hand-held GPS.

The boreholes were advanced in soil using V-Bit augering techniques. Standard Penetration Tests (SPTs) were conducted at regular intervals to assess soil strength/density and obtain samples for logging. Upon encountering rock, the boreholes were advanced to the termination depth using diamond rotary coring techniques to obtain rock core samples.

Table 1: Summary of Borehole Locations and Depths

Borehole	Easting	Northing	Termination Depth (m)
BH01	337813	6246595	5
BH02	337767	6246577	8.0
BH03	337764	6246599	8.0
CBR Sample	337817	6246614	0.5

3.2 HYDROGEOLOGICAL TESTING

A rising head permeability test was completed in borehole BH02 in general accordance with BS 5930-2015, *Code of practice for ground investigations*. The purpose of the rising head test was to facilitate preliminary assessment of potential groundwater inflow/infiltration into the proposed basement excavation. The rising head permeability test results are summarised in Section 4.2.1 with the test results enclosed in Appendix B.

3.3 GEOTECHNICAL LABORATORY TESTING

A bulk soil sample of the near surface Unit 2: Marine Sand was collected from within an excavated test pit from 0.2 m to 0.5 m depth for 4-day soaked California Bearing Ratio (CBR) testing. The sample was submitted to a NATA accredited geotechnical testing laboratory for the CBR testing to assist with assessment of road pavement design parameters. The laboratory test results are summarised in Section 4.3.1 and the laboratory test certificates are enclosed in Appendix C.

A representative sample of Unit 4: Class III Sandstone (weathered/crushed sandstone) was collected from BH01 at 3.0 m and dispatched to the laboratory for assessment of aggressivity to buried reinforced concrete structures. The laboratory test results are summarised in Section 4.3.2 and the laboratory test certificates are enclosed in Appendix C.

4 RESULTS

4.1 SUMMARY OF SUBSURFACE CONDITIONS

An inferred geotechnical model for the site is presented in Table 2. The depths of the strata are based on the depths encountered at the borehole locations relative to the ground surface at the time of the investigation and may be different at other parts of the Site. Detailed descriptions and depths of materials encountered are presented on the borehole logs included in Appendix A.

Table 2: Inferred Geotechnical Model

Geotechnical Unit	Approximate Depth to Top of Unit (m)	Approximate Thickness (m)	Typical Description
Unit 1a: Topsoil/Fill	Ground Level	0.6 to 1.5	TOPSOIL: fine Sand with trace roots, organics and gravels, dark brown, typically moist. FILL: Sand, fine, dark grey/yellow and dark brown, trace angular gravels, Sandstone fragments, moist.
Unit 1b: Concrete	Ground Level	0.1	Concrete was encountered in BH02 only.
Unit 2: Marine Sand	0.6 to 1.5	0.2 to 0.3	Very dense Sand, fine, light and dark grey, trace fine angular gravel and Sandstone fragments, moist.
Unit 3: Sandstone[1] (Class V)	0.8 to 1.8	0.2 to 1.6	SANDSTONE: medium grained, pale grey, very low to medium strength, extremely to moderately weathered with seams of highly weathered, very low to low strength rock. Defects consisting of joints, bedding plane partings, crushed seams and extremely weathered seams. Crushed seams 10% to 40% of rock mass.
Unit 4: Sandstone[1] (Class III)	2 to 2.4	Not Proven	SANDSTONE: fine to medium grained, pale grey/light grey, medium to high strength, slightly weathered to fresh. Occasional Shale laminations throughout rock. Crushed seams vary from approximately 5% to 15% of rock mass.

Notes:

[1] Rock is classified in accordance with Pells et al. 1998 (Foundations on Shale and Sandstone in the Sydney Region, Australian Geomechanics Journal) which classifies rock depending upon strength, fracturing and weak seams. The depth to rock and condition of rock should be considered a preliminary approximation and conditions may vary beyond the borehole locations.

4.2 GROUNDWATER OBSERVATIONS

Groundwater seepage inflow was observed during drilling of borehole BH02; however, groundwater seepage was not observed in boreholes BH01 and BH03. The standing groundwater depth in BH02 was measured following completion of the borehole. A summary of the standing groundwater depth observed at the time of the investigation is presented in Table 3.

Table 3: Summary of Standing Groundwater Observations

Borehole ID	Approximate Standing Groundwater Depth Below Ground Level (m)
BH01	Not Observed
BH02	5.5
BH03	Not Observed

The standing groundwater depth shown was recorded during the investigation and groundwater depths at the Site may vary with time and location due to fracturing and seams in the rock and other factors such as seasonal fluctuations and rainfall events.

4.2.1 Rising Head Permeability Test

The results of the rising head permeability test carried out in BH02 indicates a permeability (k) for the Unit 4: Class III Sandstone of 5.4 x 10^{-8} metres/second. CES notes that this is an indicative preliminary estimate. Infiltration/flow rates can vary significantly with rock fracture patterns and seams at the Site beyond the location of the borehole assessed.

Groundwater was measured at a depth of 5.5 m in borehole BH02 and the assumed maximum depth of the proposed basement excavation is 4m, hence groundwater may not be encountered

during excavation of the basement. However it should be considered that groundwater depths at the Site may vary over time due to factors such as seasonal fluctuations and rainfall events.

Following borehole completion, water in borehole BH02 was bailed with a plastic bailer to a depth of 6.2 m below the ground surface. CES was not able to bail water from the borehole beyond this depth due to sediment accumulation in the bottom of the borehole. Following bailing of the borehole, the water level was allowed to rise until a static standing level was reached, which occurred at a depth of 5.5 m below the ground surface. This occurred within a period of two hours. Following an additional hour of observation, there was no measured change in the standing groundwater depth of 5.5 m below the ground surface.

4.3 GEOTECHNICAL LABORATORY TEST RESULTS

4.3.1 California Bearing Ratio (CBR)

CBR testing was carried out on a soil sample of Unit 2: Marine Sand collected from a test pit. The sample was compacted to 100% Standard Dry Density Ratio and soaked for four days prior to testing. The test result is summarised in Table 4 and the test certificate presented in Appendix C.

Table 4: Laboratory CBR Test Result

Sample Location	Depth (m)	Geotechnical Unit	Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	CBR (%)	Swell after 4 day soaking (%)
TP01	0.2 to 0.5	Unit 2: Marine Sand	1.79	13.7	35	<1%

Note: CBR at 5.0 mm penetration carried out on 4 day soaked sample compacted to 100% Standard Maximum Dry Density.

4.3.2 Exposure Classification Testing for Concrete and Steel

The ground aggressivity test results on a representative sample of Unit 4: Class III Sandstone (weathered/crushed sandstone) from BH01 at 3.0 m are summarised in Table 5.

Table 5: Laboratory Aggressivity Results

Sample ID	BH01-3m
pH	4.9
Sulfate as SO_4, mg/kg	21
Chloride, mg/kg	<10
Exposure Classification	B[1]

Notes:

[1] Exposure classification B refers to low permeability soils or all soils above groundwater.

The test results indicate a Mild exposure classification in regard to buried reinforced concrete in accordance with AS 2159-2009 *Piling-Design and installation*.

5 DISCUSSION AND RECOMMENDATIONS

5.1 MATERIAL ENGINEERING PROPERTIES AND EARTHWORKS

Unit 1: Topsoil/ Fill should be stripped and stockpiled and assessed for possible re-use on site, for example used in landscaped areas, subject to horticultural assessment.

Where trees are required to be removed, stumps should be grubbed out and root systems cleared. Uncontrolled fill may be reused on site, provided it meets the requirements for suitable geotechnical material as defined below and is placed and compacted in accordance with a suitable engineering specification.

Based on the observations made during the fieldwork, it is not anticipated that significant amounts of groundwater will be encountered during excavation of a single level basement. However, excavations should be carried out in a manner that allows for drainage of water during rainfall events. The excavation of trenches and pumping from locally excavated sumps should be adequate to manage and control surface water at the site. The Unit 2: Marine Sand is likely to be subject to erosion or become geotechnically unstable either in a dry condition or where this material experiences a significant increase in moisture content.

Should the placement of fill be required as part of the development, the nominated area should be filled using suitable geotechnical material obtained from excavations on the Site or using

geotechnically suitable imported fill material. Suitable geotechnical material is fill that is capable of being compacted to form a homogeneous mass capable of supporting the proposed structure and/or associated elements which does not contain the following unsuitable materials:

- Organic soils such as topsoil, severely root affected subsoils and peat;
- Imported material not assessed as Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) or materials not subject to a General or Specific Resource Recovery Exception as approved by the NSW Office of Environment and Heritage. Imported fill should be accompanied by documentation adequately demonstrating the material's compliance with the exemption conditions.
- Materials containing substances which can be dissolved or leached out in the presence of moisture, or which undergo volume change or loss of strength when disturbed and exposed to moisture;
- Silts or materials that have the deleterious engineering properties of silt;
- Fill which contains wood, metal, plastic, boulders or other deleterious material;
- Loose, soft, wet or unstable soil or rock;
- Any material deemed unsuitable by the geotechnical practitioner.

Suitable geotechnical fill should be placed in near horizontal layers of uniform thickness placed systematically across the fill area. The fill should be placed in layers no greater than 200 mm compacted thickness and compacted to a minimum 98% Standard Maximum Dry Density Ratio (SMDDR) within ± 2 % of Optimum Moisture Content (OMC). Fill within 500 mm of slabs or pavements, should be compacted to a minimum 100% SMDDR within ± 2 % of OMC.

Subgrade preparation and the placement of fill at the Site should be carried out under Level 1 Supervision as defined in AS 3798-2007, *Guidelines on earthworks for commercial and residential developments*.

Erosion and sediment controls should be implemented during any earthworks operations in accordance with the requirements of the Landcom Publication *Managing Urban Stormwater: Soils and Construction*.

5.2 SITE CLASSIFICATION

For relatively light structures with size, loadings, footings and slab designs similar to that of a residential house, extension or outbuilding, the Site classification in accordance with AS 2870-2011, *Residential slabs and footings* is assessed to be Class A. This assumes that the Unit 1a: Topsoil/Fill is completely removed from site or completely excavated and recompacted as engineered fill in accordance with Section 5.1.

5.3 EXCAVATION CHARACTERISTICS

It is understood by CES that the proposed building will be constructed with a single basement excavated to approximately 3 m to 4 m depth. Based on this assumption all geotechnical units (Units 1 to 4) will require excavation during the construction of the basement.

The Unit 1a: Topsoil/Fill and Unit 2: Marine Sand should be excavatable using a hydraulic excavator and bucket or bulldozer blade. The Unit 3: Class V Sandstone is likely to require more effort and more powerful excavation plant and the use of ripper attachments. The Unit 4 Class III Sandstone would be anticipated to require excavation using rippers or hydraulic rock breakers and rock saws to facilitate excavation and removal of this material.

Contractors should be required to examine borehole records to make their own assessment of suitable excavation plant and production rates.

5.3.1 Vibration and Ground Movements

The use of rock-breaking tools, such as impact hammers, could cause vibrations that may adversely impact on nearby structures and services. It is recommended that an assessment is carried out of the proximity of vibration sensitive structures to the excavations proposed at the Site, and dilapidation surveys be undertaken prior to commencement of excavation.

Should structures that are sensitive to vibration or ground movement be assessed to be present in proximity to the Site, it is recommended that a vibration and ground movement monitoring and control plan be prepared prior to commencement of the construction works. This plan should include as a minimum the proposed vibration and ground movement monitoring programme and prescribe monitoring trigger thresholds and limits that should not be exceeded for vibration and ground movements. Plans of action to be taken, should any prescribed thresholds and limits be detected, should be included in the monitoring plan.

5.3.2 Groundwater

In terms of the basement excavation and basement retaining structures, the structure and civil design should assume that groundwater will at some point come to ground surface level. The associated hydrostatic pressures and drainage requirements should be provided in the basement design.

5.4 PERMANENT AND TEMPORARY BATTER SLOPES

Excavation is the Unit 1a: Topsoil/Fill, Unit 2: Marine Sand and Unit 3: Class V Sandstone would be expected to stand at batters of 2 Horizontal to 1 Vertical (2H:1V) for unsupported temporary batter slopes and 2.5H:1V for unsupported permanent batter slopes.

The Unit 4: Class III Sandstone should stand at 1H:3V for unsupported temporary batter slopes and 1H:2V for unsupported permanent batter slopes, using localised rock dowels/bolts where necessary and shotcrete.

5.5 RETAINING STRUCTURES

Where there is insufficient area available to form unsupported batters or where surcharge is required to be placed close to the crest of the batter the Unit 1: Fill, Unit 2: Marine Sand, Unit 3: Class V Sandstone will require excavation support. Excavation solutions could include bored piles, shoring or sheet piles.

A suitably qualified and experienced geotechnical practitioner should be consulted prior to design and installation of any engineering retaining solution and assess the suitability of the solution. To assist in the design of shoring or retaining walls, geotechnical design parameters are provided in the following sections of this report.

5.6 PAVEMENT SUBGRADE

Pavements at the Site will include a driveway ramp slab for predominantly garbage truck traffic and light duty pavements for predominantly car traffic. At the time of the investigation, the Unit 2: Marine Sand was sampled from a test pit near the proposed ramp since the sand will likely form the subgrade for the driveway ramp servicing garbage truck traffic and the basement carpark. The laboratory testing for CBR resulted in a value of 35% for the Unit 2: Marine Sand. This CBR value would be considered high for a poorly graded marine sand (i.e., a sand with little variation in grain size) but is likely the result of a small percentage of gravels present within the sand (sand with gravel). CES considers that this CBR value may be considered representative where the Unit 2: Marine Sand, sandstone or crushed sandstone is present at subgrade level in pavement areas.

The design value for imported fill should be based on testing to determine the CBR values of the particular fill to be imported.

5.7 FOOTINGS AND DESIGN PARAMETERS

5.7.1 Shallow Footings

5.7.1.1 Strip or Pad Footings

Strip or pad footings could be constructed in the Unit 3: Class V Sandstone or Unit 4: Class III Sandstone. Allowable design parameters for strip and pad footings are provided in Table 6. The use of the recommended allowable bearing pressures would be expected to result in footing settlement of about 1% of minimum footing dimensions (ultimate bearing values occur at large settlements greater than approximately 5% of the minimum footing dimension).

During construction, an experienced geotechnical engineer should observe footing excavations in order to confirm that the foundation conditions and footing elevations are suitable and consistent with adopted design parameters.

Where practicable, footings for the same structure should be founded on rock of similar strength characteristics (rock class) to minimize the risk of differential movements, with articulation provided where appropriate. Further review and analysis of bearing capacities and settlements should be carried out once the bulk excavation levels and design loads become available.

5.7.1.2 Raft Slab Footing

A raft slab may be considered. The modulus of subgrade reaction value will need to be assessed based on the design working load and size of the loaded area. Structure settlements may be assessed once loading and elevation of such developments are known.

5.7.1.3 Footings and Groundwater

Groundwater was encountered at a depth of 5.5 m below the ground surface in borehole BH02. Groundwater depths at the Site may vary and the potential for the presence of groundwater in footing excavations at the Site should be taken into consideration when planning construction. Where groundwater is present in footings excavations, excavations should be cleaned, dewatered and concreted within 24 hours to prevent softening of the footing base.

5.7.2 Bored or CFA Piles

Open bored piles or continuous flight auger piles could be adopted for the planned development. It would be expected that appropriate capacity piling rigs should be able to penetrate into the Unit 3: Class V and Unit 4: Class III Sandstone. Allowable design parameters for bored piles are provided in Table 6. The use of the recommended allowable bearing pressures would be expected to result in pile settlement of about 1% of pile diameters (ultimate bearing values occur at large settlements greater than approximately 5% of the minimum footing dimension).

During construction, an experienced geotechnical engineer should observe boring of the piles in order to confirm that the foundation conditions and pile footing elevations are suitable and consistent with adopted design parameters.

Table 6: Preliminary Footing Design Parameters

Geotechnical Unit	Ultimate Bearing Pressures (kPa)[1]	Allowable Bearing Pressures (kPa)[1]	Ultimate Pile Adhesion (kPa)[1,2]	Typical E_{field} (kPa)
Unit 3: Class V Sandstone	3,000	1,000	150	75
Unit 4: Class III Sandstone	25,000	6,000	1000	700

Notes:

[1]Shaft adhesion should only be assumed where piles have a minimum embedment of at least 3 pile diameters into the nominated stratum with a properly cleaned rough socket (at least grooves of depth 1 mm to 4 mm and width greater than 5 mm spacing of 50 mm to 200 mm).

[2]For uplift capacity, the ultimate shaft adhesion value may be used but should be multiplied by a geotechnical reduction factor (ϕ_g) of 0.5. In addition to shaft adhesion, the uplift capacity should be checked for a cone pull-out failure mode assuming a cone angle of 60° considering the submerged weight of the soil or rock and adopting a factor of safety of 1.0 against pull-out.

Open bored piles may require temporary liners to provide bore wall stability through the Unit 1: Topsoil/Fill and the Unit 2: Marine Sand or where groundwater is encountered. Piles should be cleaned, dewatered and concrete placed without delay to prevent softening of the pile base.

Groundwater was encountered at a depth of 5.5 m in borehole BH02. The potential for the presence of groundwater in bored pile excavations should be taken into consideration when planning construction. Where groundwater is present in bored pile excavations, the excavation

should be cleaned, dewatered and concreted within 24 hours to prevent softening of the footing base.

5.8 DESIGN PARAMETERS FOR SHORING AND RETAINING WALLS

Geotechnical parameters for design of shoring or retaining walls based on the results of the geotechnical investigation are presented in Table 7.

Table 7: Design Parameters for Shoring or Retaining Walls

Geotechnical Unit	γ (kN/m^3)	C_u (kPa)	c' (kPa)	ϕ' (º)	E Elastic Modulus (MPa)	ν (Poisson's ratio)	K_a[1]	K_p
Unit 1: Topsoil/Fill	20	0	0	24	---	---	0.3	3.0
Unit 2: Marine Sand	20	0	0	30	25	0.3	0.3	3.0
Unit 5: Class V Sandstone	20	---	300	30	50	0.3	0.3	3.0

Notes:

[1]Use of the active earth pressure coefficient (K_a) requires that there will be sufficient deflection of the retaining system during construction to reach active conditions. If lateral deflections are inhibited, the at-rest earth pressure coefficient (K_o) should be used. A K_o value of 0.5 may be used for both the Unit 1: Topsoil/Fill and Unit 2: Marine Sand.

The design values given are based on level ground behind the wall and do not include any surcharge loads that may be imposed near the top of the retaining system/wall, such as vehicle loads. All surcharge loading should be taken into consideration in the retaining system/wall design.

5.9 SEISMICITY

A Hazard Factor (Z) of 0.08 is appropriate for the development Site, which is assigned sub-soil class C_e in accordance with Australian Standard AS1170.4 – 2007 Structural Design Actions – Part 4: Earthquake Actions in Australia.

5.10 GEOTECHNICAL CONSTRAINTS

Excavation for the basement and pile bores without adequate support may result in instability of the ground where Unit 1a: Topsoil/Fill, Unit 2: Marine Sand and Unit 3: Class V Sandstone

materials are excavated. The excavation/earthworks and piling contractors should be aware of the potential for instability of these materials when planning construction.

Groundwater was encountered in one borehole (BH02) at the Site at a depth of 5.5 m. Groundwater depths at the Site may vary with time and location due to fracturing and seams in the rock and other factors such as seasonal fluctuations and rainfall events. In addition, infiltration/flow rates can vary significantly with rock fracture patterns and seams at the Site beyond the location of the borehole assessed. The potential for the presence of groundwater in excavations and bores at the Site should be taken into consideration when planning construction.

The close proximity of the neighbouring roads and pavements, buildings and underground services may be affected by excavation and construction activities at the Site. This may include, if adequate management and mitigation measures are not implemented, the potential for adverse impacts from noise, vibration and ground movement associated with the excavation and construction works.

6 LIMITATIONS OF THIS REPORT

This report has been prepared for use by the client who commissioned the works in accordance with the project brief and based on information provided by the client. The advice contained in this report relates only to the current project and all results, conclusions and recommendations should be reviewed by a competent person with experience in geotechnical and environmental investigations before being used for any other purpose. Consulting Earth Scientists Pty Ltd (CES) accepts no liability for use or interpretation by any person or body other than the client. This report must not be reproduced except in full and must not be amended in any way without prior approval by the client and CES.

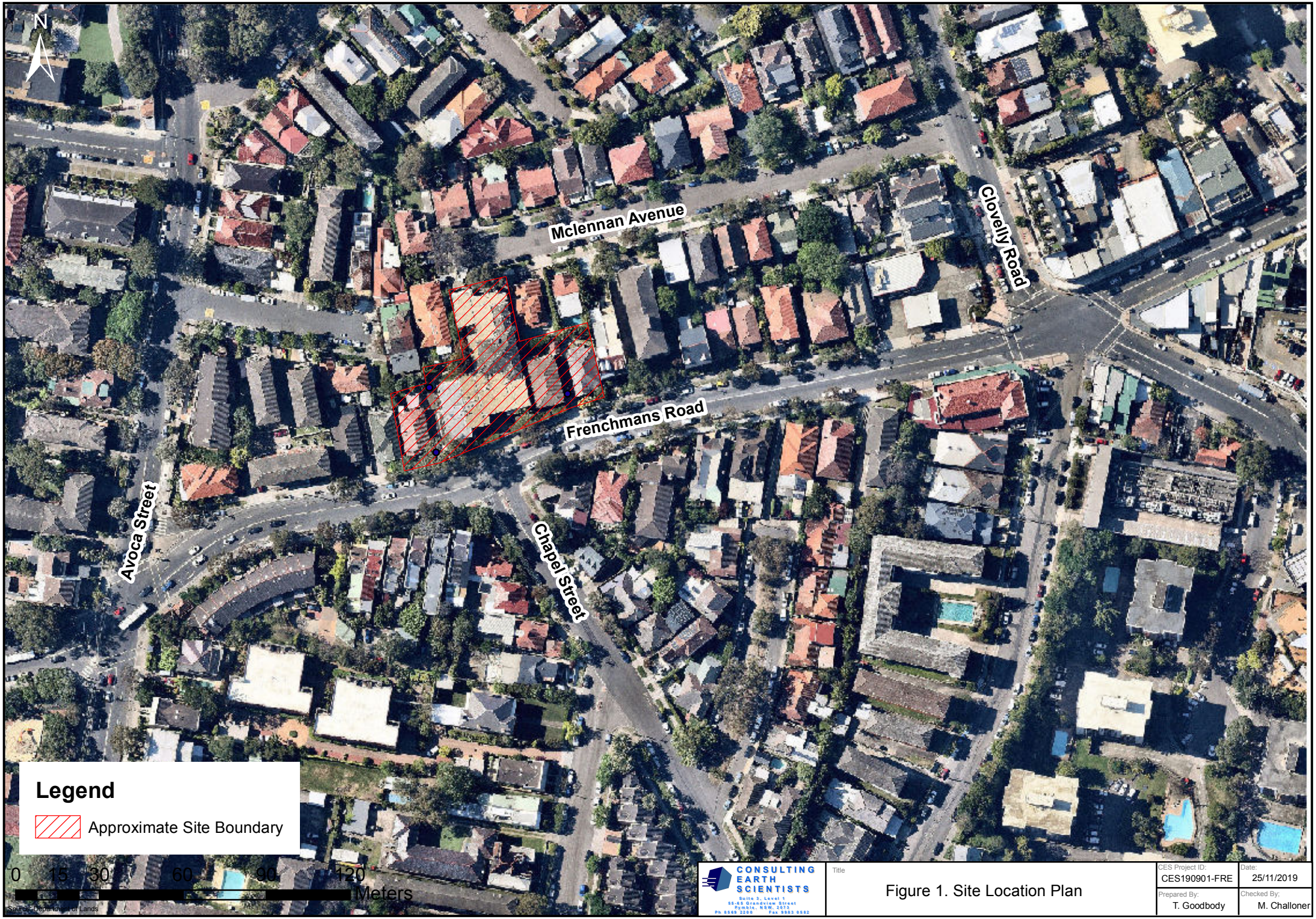
It should be noted that three boreholes were drilled within the Site during the investigation. Therefore, the geotechnical model was inferred only and may not fully represent the accuracy of the overall ground conditions across the Site. Spatial variability in ground conditions within the Site can occur even at small distances between exploratory holes. Excavation for footing bases and other purposes will confirm the likelihood of such ground variability.

This report does not provide a complete assessment of the geotechnical or environmental status of the Site and is limited to the scope defined therein. Should information become available regarding conditions at the Site including previously unknown sources of contamination, CES reserves the right to review the report in the context of the additional information.

7 REFERENCES

- Landcom publication, 2004. *Managing Urban Stormwater: Soils and Construction*. Fourth Edition, NSW Government.
- Standards Australia, 2007. *AS 3798-2007 – Guidelines on Earthworks for Commercial and Residential Developments*.
- Standards Australia, 1996. *AS 2870-1996 – Residential Slabs and Footings Construction*.
- Standards Australia, 2009. *AS 2159-2009 Piling - Design and Installation.*
- British Standard *BS 5930-2015, The code of practice for ground investigations.*

FIGURES



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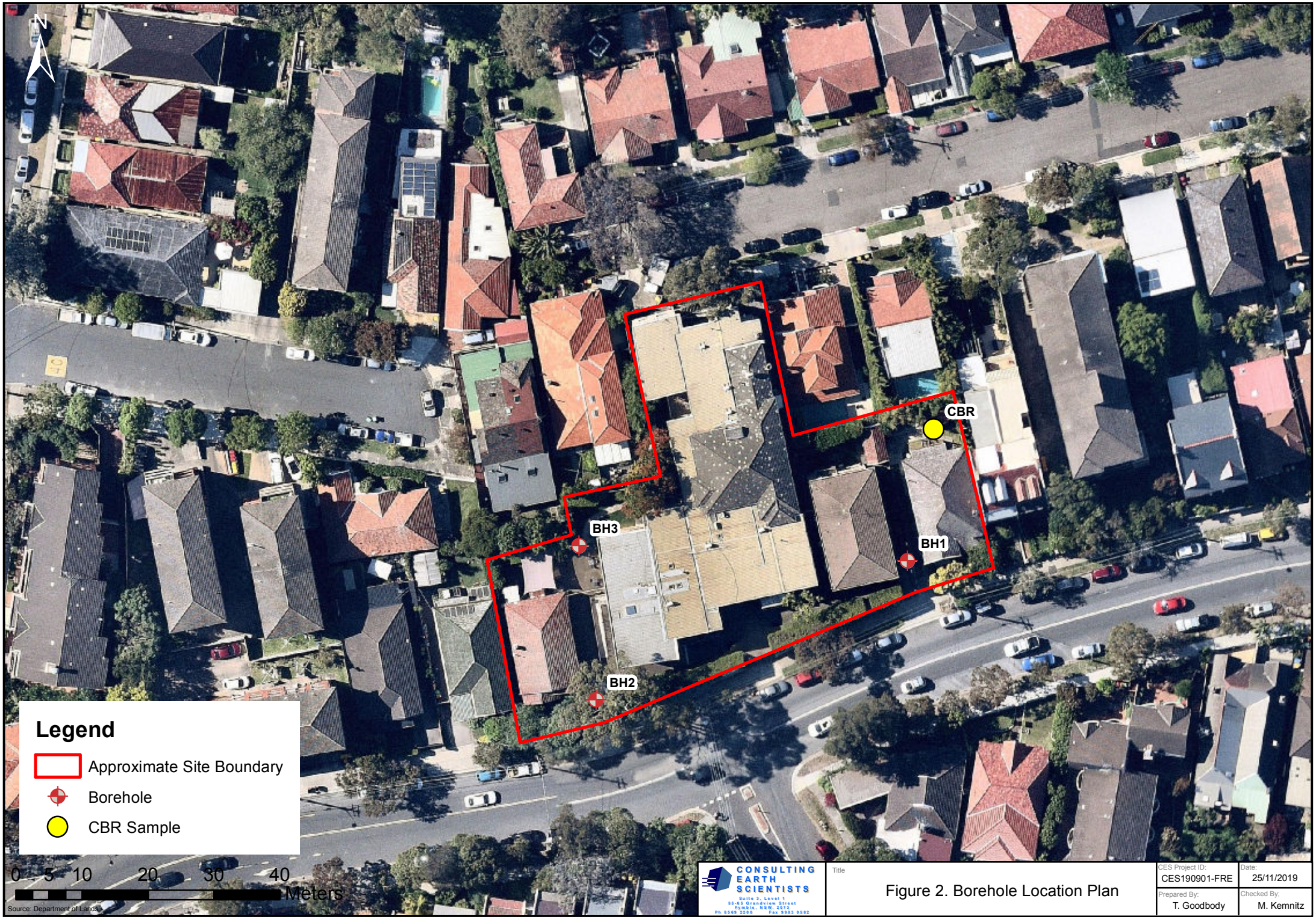
Title

Figure 1. Site Location Plan

CES Project ID:	Date:
CES190901-FRE	25/11/2019
Prepared By:	Checked By:
T. Goodbody	M. Challoner



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Title

Figure 2. Borehole Location Plan

CES Project ID:	Date:
CES190901-FRE	25/11/2019
Prepared By:	Checked By:
T. Goodbody	M. Kemnitz

APPENDIX A: GEOTECHNICAL BOREHOLE LOGS

Project ID:	CES190901-FRE	CONSULTING EARTH SCIENTISTS	**LOG ID: BH01**
Client:	Frenchmans Lodge Properties Pty Ltd	Suite 3, Level 1 55 Grandview Street, Pymble, NSW 2073 PH: (02) 8569 2200 FAX: (02) 9552 4399 www.consultingearth.com.au	Sheet: 1 of 1
Project:	Environmental and Geotechnical Site Investigation		
Location:	11-19 Frenchmans Road, Randwick, NSW		

X-Coord:	337813.1	**Date Commenced:**	07/11/2019	**Logged by:**	BR
Y-Coord:	6246595.5	**Date Completed:**	07/11/2019	**Checked by:**	MK
Surface Elevation (R.L) :		**Hole Diameter (mm):**	110 mm		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	0					Topsoil: SAND, fine, dark brown/yellow. Trace grass, leaves and roots, moist.						
						FILL: SAND, fine, dark brown/yellow. Trace Sandstone fragments. Trace grass and roots, moist.			BH01 - 0.5 m - Fill	SPT at 0.5 m {6, >30} refusal		
					SP	SAND: fine, dark brown/yellow. Trace Sandstone fragments. Trace grass and roots, moist.	VD					
						Begin core drilling at 0.8 m bgl. Refer to BH01 corelog for details						
1	-1											

Project ID: CES190901-FRE
Client: Frenchmans Lodge Propertites Pty Ltd
Project: Environmental and Geotechnical Site Investigation
Location: 11-19 Frenchmans Road, Randwick, NSW

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Corehole ID: BH01

Sheet: 1 of 1

X-Coord: 337813.1
Y-Coord: 6246595.5
Surface Elevation (R.L.): Surf Elevation AHD
Date Commenced: 07/11/2019
Date Completed: 07/11/2019
Hole Diameter (mm): 75 MM
Logged by: BR
Checked by: MK

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
1	-1	NMLC Core	0%			Refer to BH01 borelog for details.						
						Sandstone: fine grained, light brown, very low strength, extremely weathered.	XW					0.88~0.9 m, CZ, 0, R, Cu, EW
												0.96 m, P, 0, R, Cu, EW
						Sandstone: fine grained, pale grey, low strength, moderately weathered, horizontal laminations of fine grained Shale, 10~20 mm spacing, 2~3 mm thick.	MW			20%		1.17~1.21 m, CZ, 0, R, Cu, EW
												1.32 m, P, 5, R, Cu, MW
2	-2											1.72~ 2 m, CZ, 0, R, Cu, MW
												2.08~2.34 m, CZ, 0, R, Cu, MW
						Sandstone: fine grained, pale grey, low strength, moderately weathered.	MW			62%		2.5 m, P, 5, R, Cu, MW
3	-3											3.19~3.21 m, CZ, 0, R, Cu, MW
												3.61~3.63 m, CZ, 0, R, Cu, MW
												3.68~3.71 m, CZ, 0, R, Cu, MW
						SAND: fine, pale grey, moist, dense						
4	-4					Sandstone: fine grained, pale grey, low strength, moderately weathered.						3.84 m, P, 10, R, Cu, MW
						Sandstone: fine to medium grained, dark pink, low strength, moderately weathered.	MW			0%		4.6~4.61 m, CZ, 0, R, Cu, MW
												4.73~5 m, CZ, 0, R, MW
5	-5					End of hole at 5 m. Target depth.						
6												

Project ID:	CES190901-FRE
Client:	Frenchmans Lodge Properties Pty Ltd
Project:	Environmental and Geotechnical Site Investigation
Location:	11-19 Frenchmans Road, Randwick, NSW

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LOG ID: BH02

Sheet: 1 of 1

X-Coord:	337767.4	**Date Commenced:**	06/11/2019	**Logged by:**	BR
Y-Coord:	6246577.6	**Date Completed:**	06/11/2019	**Checked by:**	MK
Surface Elevation (R.L) :		**Hole Diameter (mm):**	110 mm		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	0					Concrete: Pavement						
						FILL: SAND, fine, brown/dark brown. Trace angular gravel. Trace roots, moist			BH02 - 0.5 m - Fill	SPT at 0.5 m {4, >30} refusal		
					SP	SAND: fine, brown/dark brown. Trace angular gravel. Trace roots, moist	VD					
						Begin core drillng at 0.75 m bgl. Refer to BH02 corelog for details						
1	-1											

Project ID:	CES190901-FRE
Client:	Frenchmans Lodge Propertites Pty Ltd
Project:	Environmental and Geotechnical Site Investigation
Location:	11-19 Frenchmans Road, Randwick, NSW

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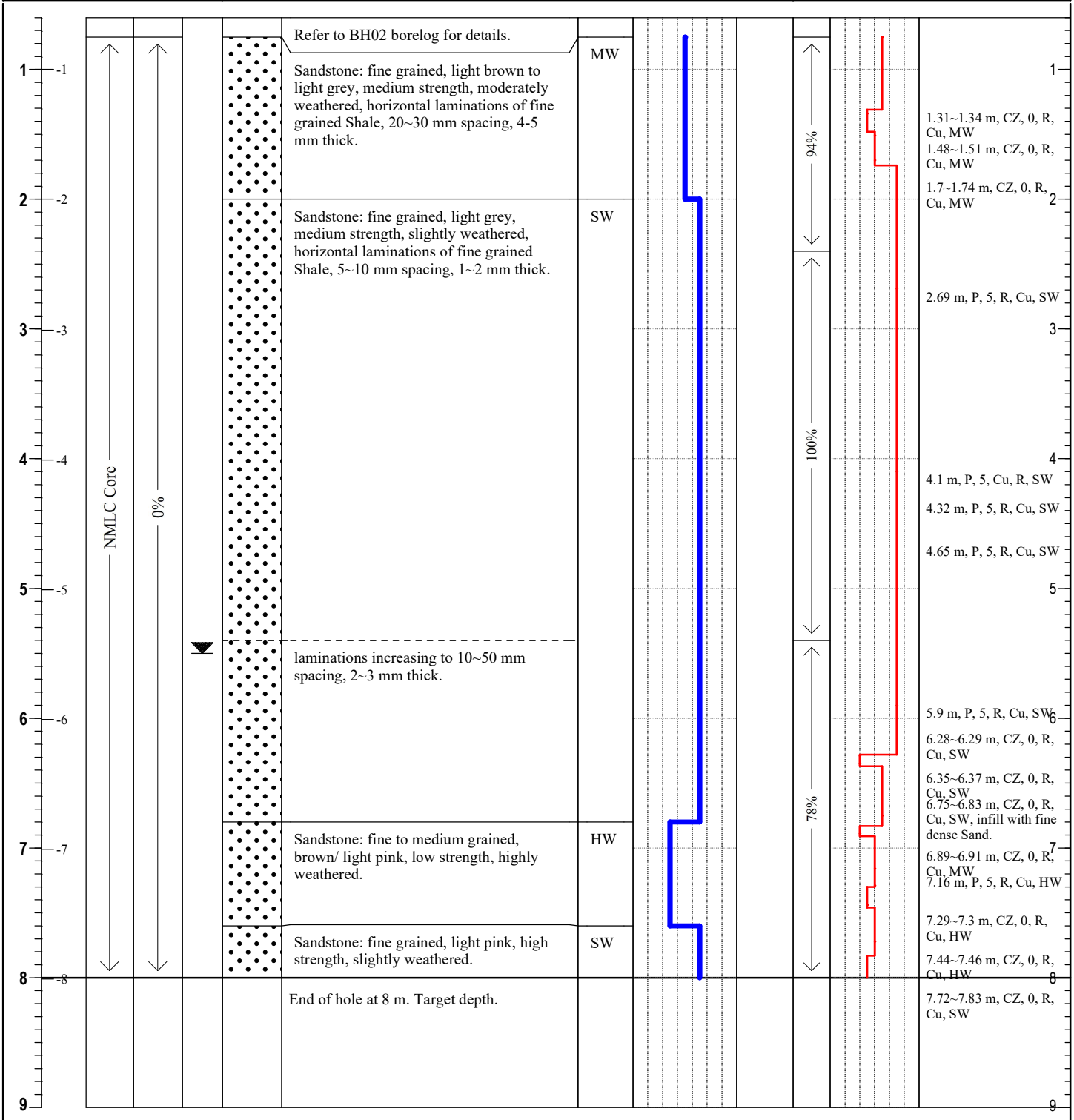
Corehole ID: BH02

Sheet: 1 of 1

X-Coord:	337767.4	**Date Commenced:**	07/11/2019	**Logged by:**	BR
Y-Coord:	6246577.6	**Date Completed:**	07/11/2019	**Checked by:**	MK
Surface Elevation (R.L):		**Hole Diameter (mm):**	75 MM		

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description



Refer to BH02 borelog for details.

MW

Sandstone: fine grained, light brown to light grey, medium strength, moderately weathered, horizontal laminations of fine grained Shale, 20~30 mm spacing, 4-5 mm thick.

SW

Sandstone: fine grained, light grey, medium strength, slightly weathered, horizontal laminations of fine grained Shale, 5~10 mm spacing, 1~2 mm thick.

laminations increasing to 10~50 mm spacing, 2~3 mm thick.

HW

Sandstone: fine to medium grained, brown/ light pink, low strength, highly weathered.

SW

Sandstone: fine grained, light pink, high strength, slightly weathered.

End of hole at 8 m. Target depth.

1.31~1.34 m, CZ, 0, R, Cu, MW
1.48~1.51 m, CZ, 0, R, Cu, MW
1.7~1.74 m, CZ, 0, R, Cu, MW
2.69 m, P, 5, R, Cu, SW
4.1 m, P, 5, Cu, R, SW
4.32 m, P, 5, R, Cu, SW
4.65 m, P, 5, R, Cu, SW
5.9 m, P, 5, R, Cu, SW
6.28~6.29 m, CZ, 0, R, Cu, SW
6.35~6.37 m, CZ, 0, R, Cu, SW
6.75~6.83 m, CZ, 0, R, Cu, SW, infill with fine dense Sand.
6.89~6.91 m, CZ, 0, R, Cu, MW
7.16 m, P, 5, R, Cu, HW
7.29~7.3 m, CZ, 0, R, Cu, HW
7.44~7.46 m, CZ, 0, R, Cu, HW
7.72~7.83 m, CZ, 0, R, Cu, SW

Project ID:	CES190901-FRE
Client:	Frenchmans Lodge Properties Pty Ltd
Project:	Environmental and Geotechnical Site Investigation
Location:	11-19 Frenchmans Road, Randwick, NSW

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LOG ID: BH03

Sheet: 1 of 1

X-Coord:	337764	**Date Commenced:**	06/11/2019	**Logged by:**	BR
Y-Coord:	6246599	**Date Completed:**	06/11/2019	**Checked by:**	MK
Surface Elevation (R.L) :		**Hole Diameter (mm):**	110 mm		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	0					Topsoil: SAND, fine, dark brown/yellow. Trace gravel. Trace grass, leaves and roots, moist.						
						FILL: SAND, fine, dark grey/brown. Trace silt and roots, moist.				SPT at 0.5 to 0.95 m {2,2,2} N=4		
									BH03 - 1.5 m - Fill			
1	-1				SP	SAND: fine, light grey/dark grey, trace fine angular gravel, moist, very dense.	VD		BH03 -1.75 m - SAND	SPT at 1.5 to 1.75 m {10, >30} refusal		
						Begin core drilling at 1.75 m bgl. Refer to BH03 corelog for details						
2	-2											

Drill Company:	Hagstrom Drilling Pty Ltd	**Operator Name:**	Steve Bennett
Machine Type:	DB08		

Refer to Standard Sheets for details of abbreviations

Project ID:	CES190901-FRE
Client:	Frenchmans Lodge Propertites Pty Ltd
Project:	Environmental and Geotechnical Site Investigation
Location:	11-19 Frenchmans Road, Randwick, NSW

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Corehole ID: BH03

Sheet: 1 of 1

X-Coord:	337764	**Date Commenced:**	06/11/2019	**Logged by:**	BR
Y-Coord:	6246599	**Date Completed:**	06/11/2019	**Checked by:**	MK
Surface Elevation (R.L):		**Hole Diameter (mm):**	75 MM		

Drilling Information | **LITHOLOGY** | **Natural Defects**

Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description (ROCK TYPE: grain characteristics, colour structure, minor components)	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
2	-2	NMLC Core	0%			Refer to BH03 borelog for details.	EW					
						Sandstone: fine grained, dark grey/ brown, extremely low strength, extremely weathered, trace fine, brown Sand.	MW					2.34 m, P, 5, R, Cu, MW
						Sandstone: fine grained, light grey, medium strength, moderately weathered, horizontal laminations of fine grained Shale, 20~30 mm spacing, 1~2 mm thick.	SW					2.6 m, P, 5, R, Cu, SW
3	-3					Sandstone: fine grained, pale grey, high strength, slightly weathered, horizontal laminations of fine grained Shale, 10~20 mm spacing, 1~2 mm thick. Trace fine, brown Sand.				88%		3.08~3.1 m, CZ, 0, R, Cu, SW
4	-4											
5	-5											5.38~5.39 m, CZ, 0, R, Cu, SW
						Sandstone: fine grained, light brown/ light grey, high strength, fresh. Trace fine, light grey Sand.	FR					5.53~5.54 m, P, 5, Cu, R, FR
6	-6											5.59~5.64 m, CZ, 5, R, Cu, FR
												6.16~6.17 m, CZ, 0, R, Cu, FR
7	-7									94%		6.63~6.65 m, SZ, 0, R, Cu, FR
												7.49~7.51 m, SZ, 0, R, Cu, FR
8	-8											7.7~7.71 m, SZ, 0, R, Cu, FR
						End of hole at 8 m. Target depth.						
9												

Drill Company:	Hagstrom Drilling Pty Ltd	**Operator Name:**	Steve Bennett
Machine Type:	DB08		

Refer to Standard Sheets for details of abbreviations

APPENDIX B: FIELD TEST RESULTS

Rising Head Hydraulic Conductivity Testing

CONSULTING EARTH SCIENTISTS

Project:	Geotechnical Site Investigation	CES Project Reference:	CES190901-FRE
Client:	Lendlease Building Pty Ltd	Date:	06.11.19
Location:	11-19 Frenchmans Rd, Randwick NSW	Calculated by:	MK

Rising Head Permeability Test Results
Borehole BH02
Date of Assessment: 06.11.19

Field Measurements (measurements taken after bailing borehole):

Date	Time (hr)	Water Depth (m)
06.11.19	12:40	6.2
	13:40	5.7
	14:40	5.5
	16:40	5.5

t2 =	14.67	hr, final reading
t1 =	12.67	hr, first reading
d2 =	5500	mm, depth bgl
d1 =	6200	mm, depth bgl

Method: British Standard (BS) 5930: 1981
Test No. BH02

Diam (D) =	75	mm
Area (A) =	4418	mm2
F =	3738	mm
t2 =	52812	sec
t1 =	45612	sec
H2 =	2500	mm
H1 =	1800	mm
L =	2500	mm

Perm (k) = 5.4E-08 m/s (inflow)

q = 1.5E-03 m^3/hr (rate of flow)

APPENDIX C: LABORATORY TEST RESULTS

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

CERTIFICATE OF ANALYSIS 230513

Client Details

Client	Consulting Earth Scientists Pty Ltd
Attention	Tristan Goodbody, Max Kemnitz, Bowen Ren
Address	Suite 3, Level 1, 55 Grandview Street, Pymble, NSW, 2073

Sample Details

Your Reference	**CES190901-FRE**
Number of Samples	1 Sandstone
Date samples received	11/11/2019
Date completed instructions received	11/11/2019

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.

Report Details

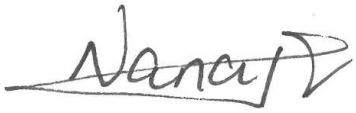
Date results requested by	18/11/2019
Date of Issue	18/11/2019

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

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

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil		
Our Reference		230513-1
Your Reference	UNITS	BH1-3.0
Depth		3.0m
Date Sampled		06/11/2019
Type of sample		Sandstone
Date prepared	-	12/11/2019
Date analysed	-	12/11/2019
pH 1:5 soil:water	pH Units	4.9
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	21

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. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			12/11/2019	[NT]	[NT]	[NT]	[NT]	12/11/2019	[NT]
Date analysed	-			12/11/2019	[NT]	[NT]	[NT]	[NT]	12/11/2019	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	113	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	119	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

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: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics 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 sam

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.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 42 43 44

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph 02 9910 6200 / sydney@envirolab.com.au

Perth Lab - MPL Laboratories
16-18 Hayden Crt Myaree, WA 6154
Ph 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
1A Dalmore Drive Scoresby VIC 3179
Ph 03 9763 2500 / melbourne@envirolab.com.au

Brisbane Office - Envirolab Services
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Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph 0406 350 706 / adelaide@envirolab.com.au

Client: Consulting Earth Scientists	Client Project Name / Number / Site etc (ie report title): CES190901-FRE
Contact Person: B. Ren	
Project Mgr: M. Kemnitz	PO No.:
Sampler: B. Ren	Envirolab Quote No. :
Address: Level 1 Suite 3, 55-65 Grandview Street, Pymble NSW	Date results required: Or choose: **standard** / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: (02) 8569 2200 Mob: 0400 305 094	Report format: esdat / equis /
Email: max.kemnitz@consultingearth.com.au; bowen.ren@consultingearth.com.au tristan.goodbody@consultingearth.com.au	Lab Comments:

Sample Information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	PH	Chloride	Sulphate (SO4)	combination 6a	metalloids	asbestos								Provide as much information about the sample as you can
	~~BH2 0.5m~~ 1BH1	~~0.5m~~	~~06.11.19~~ 08.11.19	~~Soil~~														For aggressivity
(1)	BH2 - 3.0m	3.0m	06.11.19	SANDSTONE	/	/	/											Sandstone to be crushed for testing

Envirolab Services
12 Ashley St
Chatswood NSW 2067
PH: (02) 9910 6200

Job No: 230515
Date Received: 11/11/19
Time Received: 1550
Received by: CM
Temp: Cool/Ambient
Cooling: Icepack
Security: Intact/Broken/None

Relinquished by (Company):	CES	Received by (Company): ELS sydney
Print Name:	Max Kemnitz ~~Bowen Ren~~	Print Name: CLAIRE MCLENNAN
Date & Time:	11.11.19	Date & Time: 11/11/19 1330
Signature:		Signature: Claire McLennan

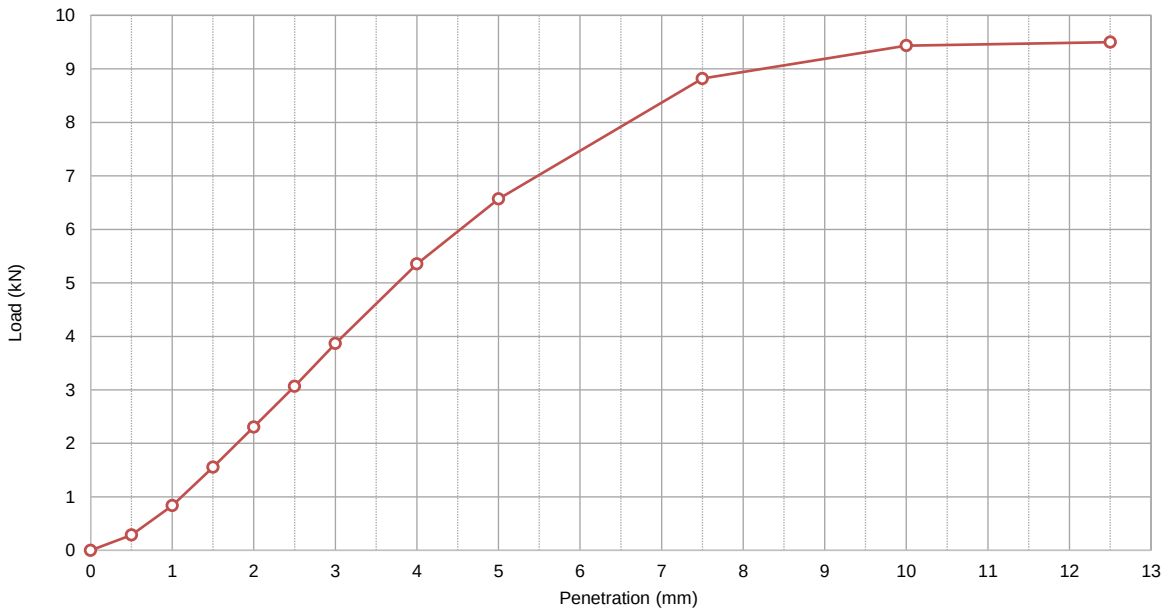
Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 21.4 (if applicable)
Transported by: Hand delivered / courier

CALIFORNIA BEARING RATIO REPORT

Client	Consulting Earth Scientists	**Source**	CBR 0.2 - 0.5m
Address	Suite 3, Level 1, 55, Grandview Street, Pymble, NSW, 2073	**Sample Description**	Silty SAND trace of Gravel
Project	Geotechnical Investigation (CES190901-FRE)	**Report No.**	S55524-CBR
Job No.	S19535	**Sample No.**	S55524

Test Procedure:				
☑	AS 1289.6.1.1	☐	RMS T117	California Bearing Ratio
☑	AS 1289.5.1.1	☐	RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
☐	AS 1289.5.2.1	☐	RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
☑	AS 1289.2.1.1	☐	RMS T120	Moisture Content - Oven Drying Method (Standard Method)

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



Preparation & Specification		**Density & Moisture**	**Achieved**	**Target**
Retained on 19.0mm Sieve (%)	1	Lab Moisture Ratio - LMR (%)	99.5	100.0
Method of Establishing Plasticity Level	Technician Assessment	Lab Density Ratio - LDR (%)	100.0	100.0
Sample Curing Time (hrs)	48 hrs	Dry Density - At Compaction (t/m³)	1.79	1.79
Compaction Hammer Used	Standard	Dry Density - After Soaking (t/m³)	1.79	
Surcharge Mass Applied (kg)	4.5	Specimen Swell (%)	0.0	
Period of Soaking (Days)	4	Moisture Content - At Compaction (%)	13.7	
Maximum Dry Density - MDD (t/m³)	1.79	Moisture Content - Top 30mm (%)	15.7	
Optimum Moisture Content - OMC (%)	13.7	Moisture Content - Remainder (%)	14.6	

Material CBR Value (%): **35** **at a penetration of** **5.0** **mm**

Notes:

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Authorised Signatory:

2/12/2019

Chris Lloyd Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

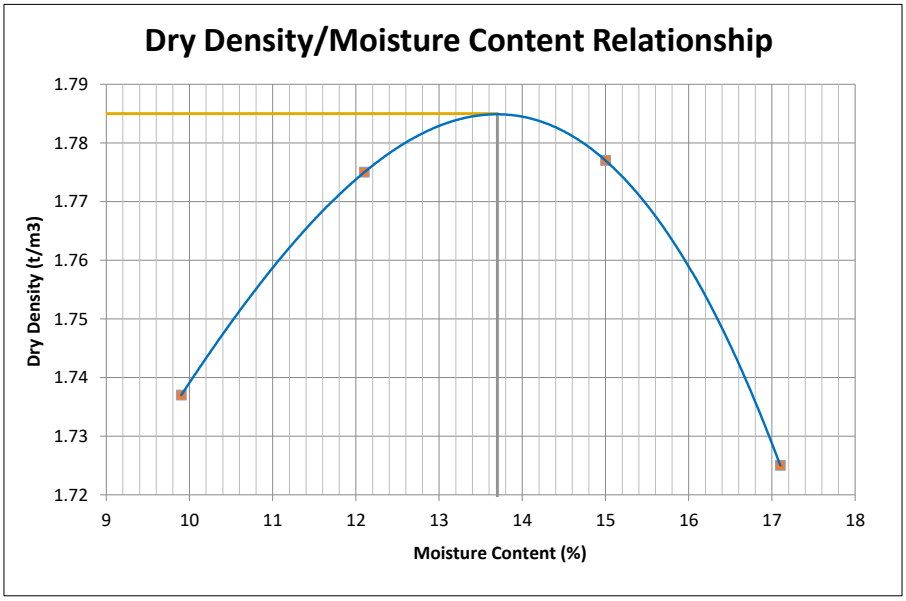
Client	Consulting Earth Scientists	**Source**	CBR 0.2 - 0.5m
Address	Suite 3, Level 1, 55, Grandview Street, Pymble, NSW, 2073	**Sample Description**	Silty SAND trace of Gravel
Project	Geotechnical Investigation (CES190901-FRE)	**Report No**	S55524-MDD
Job No	S19535-1	**Sample No**	S55524

Test Procedure:

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

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



Maximum Dry Density (t/m^3)	1.785
Optimum Moisture Content (%)	13.7
Oversize Retained on 19mm sieve (%)	0.6
Oversize Retained on 37.5mm sieve (%)	0.0
Curing Time	72 hrs
Liquid Limit Determination	Technician Assessment

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