Geotechnical Investigation Report

# GEOTECHNICAL INVESTIGATION AND SLOPE RISK ASSESSMENT

## 15A-15B MOSELEY STREET & 25-31 DONALD STREET CARLINGFORD NSW

Prepared for:

**CAPTAG INVESTMENTS PTY LTD**

**Reference: P2914_01 Rev5**

**14 July 2025**

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# 1 INTRODUCTION

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Investigation to provide geotechnical advice and recommendations for the proposed development at 15A-15B Moseley Street & 25-31 Donald Street Carlingford NSW (the site).

## 1.1 Proposed Development

Architectural Drawings for the proposed development have been prepared by Capio for Captag Investments with project number 23002, dated April 2025 Revision D. Morrow Geotechnics understands that the proposed development involves demolition of the existing buildings and the construction of two multi-storey buildings, with basement parking, civil works and related landscaping. Excavation for the proposed basement is expected to extend to a depth of up to approximately 10.5 m below ground level (mBGL). Morrow Geotechnics has been informed the proposed development has been allocated the SSD application number: SSD 83870463.

## 1.2 Purpose of the Investigation

The purpose of the investigation is to provide geotechnical advice and recommendations addressing:

- Expected subsurface conditions;
- Geotechnical parameters for foundation design;
- Site classification for slab and foundation design;
- Geotechnical construction considerations; and
- Slope Stability Risk Assessment in accordance with Australian Geomechanics Society Guidelines on Slope Stability 2007 for risk assessment of the rock slope at the site.

## 1.3 Investigation Methods

Fieldwork was undertaken on 31 May 2023. Work carried out as part of this investigation includes:

- Review of publicly available information from previous reports in the project area, published geological and soil mapping and government agency websites;
- Site walkover inspection by a Geotechnical Engineer and Engineering Geologist to assess topographical features, condition of surrounding structures and site conditions;
- Dial Before You Dig (DBYD) services search of proposed borehole locations;
- Drilling of six boreholes (BH1 to BH6) using a trailer mounted rig to depths between 4.0 and 5.0 metres. Borehole locations and site section are shown on **Figure 1**, and the borehole logs are attached to this report;
- Dynamic Cone Penetrometer tests were undertaken adjacent or within borehole locations. DCP test results were used to assess soil consistency/density and to infer top of rock;
- Groundwater observations within boreholes during drilling; and
- A Slope Risk Assessment in accordance with Australian Geomechanics Society Guidelines on Slope Stability 2007 for risk assessment of the rock slope at the site.

# 2 Desktop Review of Site Conditions

## 2.1 Published Geological Mapping

Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1983), indicates that the site overlies Ashfield Shale, which typically comprises black to dark grey shale and laminite.

## 2.2 Published Soil Landscapes

The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 indicates that the erosional landscape at the site likely comprises the Glenorie Landscape. This landscape type typically includes undulating to rolling hills on Wianamatta Group shales. Soils are generally shallow to moderately deep (0.7 to 1.5 m) red podzolic soils on crests and upper slopes. These soils are noted present high soil erosion hazard, localised impermeable, highly plastic, moderately reactive soil.

## 2.3 Subsurface Conditions

The stratigraphy at the site is characterized by a topsoil, residual soil overlying Shale bedrock. For the development of a site-specific geotechnical model, the observed stratigraphy has been divided into three geotechnical units. A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 1**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in **Appendix A**.

**TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS**

| Unit | Material | Comments |
|---|---|---|
| **1** | **Topsoil/Fill** | Mixed silt and clay with gravel and sand. Unit 1 is inferred to be uncontrolled and poorly compacted. |
| **2** | **Stiff to Very Stiff Clay** | Medium to high plasticity residual clay. Stiff to very stiff consistency with some ironstone bands. |
| **3** | **Hard Clay** | Medium to high plasticity residual clay. Hard consistency with some light ironstone bands. |
| **4** | **Class V Shale** | Extremely weathered shale with some clay bands, inferred very low strength. |
| **5** | **Class IV Shale** | Highly weathered shale, inferred low strength and strength. |
| **6** | **Class IV Shale** | Highly to Moderately weathered shale, inferred low to medium strength grading stronger with depth. |

***Notes:***

1 Depths shown are based on material observed within test locations and will vary across the site.

**TABLE 2 SUMMARY OF SUBSURFACE CONDITIONS AT INVESTIGATION LOCATIONS**

| Depth to Material mBGL (RL mAHD) | Unit 1 Topsoil/Fill | Unit 2 St-Vst Clay | Unit 3 Hard Clay | Unit 4 Class V Shale | Unit 5 Class IV Shale | Unit 6 Class III Shale |
|---|---|---|---|---|---|---|
| **BH1** | 0.0 to 0.3 (101.58 to 101.28 ) | 0.3 to 1.3 (101.28 to 100.28) | - | 1.3 to 3.0 (100.28 to 98.58) | 3.0 to 4.0 (98.58 to 97.58) | 4.0+ (97.58+) |
| **BH2** | 0.0 to 0.2 (104.28 to 104.08) | 0.2 to 1.1 (104.08 to 103.18) | 1.1 to 1.4 (103.18 to 102.88) | 1.4 to 4.0 (102.88 to 100.28) | 4.0 to 4.6 (100.28 to 99.68) | 4.6+ (99.68+) |
| **BH3** | 0.0 to 0.4 (104.17 to 103.77) | 0.4 to 1.0 (103.77 to 103.17) | 1.0 to 1.5 (103.17 to 102.67) | 1.5 to 4.2 (102.67 to 99.97) | 4.2 to 4.5 (99.97 to 99.67) | 4.5+ (99.67+) |
| **BH4** | 0.0 to 0.4 (101.3 to 100.9) | 0.4 to 2.2 (100.9 to 99.1) | 2.2 to 2.7 (99.1 to 98.6) | 2.7 to 4.0 (98.6 to 97.3) | 4.0 to 5.0 (97.3 to 96.3) | 5.0+ (96.3+) |
| **BH5** | - | 0.0 to 1.0 (103.41 to 102.41) | 1.0 to 2.7 (102.41 to 100.71) | 2.7 to 4.0 (100.71 to 99.41) | 4.0 to 4.5 (99.41 to 98.91) | 4.5+ (98.91+) |
| **BH6** | - | 0.0 to 0.8 (106.56 to 105.76) | 0.8 to 1.6 (100.76 to 104.96) | 1.6 to 4.3 (104.96 to 102.16) | 4.3 to 4.8 (102.16 to 101.66) | 4.8+ (101.66+) |

## 2.4 Groundwater Observations

Seepage was not noted in any of the boreholes. Minor seepage is expected within open excavations at the soil/rock boundary in response to surface water infiltration during rainfall events.

# 3 Discussions and Recommendations

## 3.1 Slope Risk Assessment

A Slope Risk Assessment has been carried out for the site in general accordance with Australian Geomechanics Society 2007 Guidelines. This assessment is based on surface conditions observed during the inspection and subsurface conditions inferred from mapped regional geology. These guidelines allow the stability of the slope/ structure to be assessed in terms of risk to property and loss of life based on the physical features of the slope. Typical risk indicators of potential slope instability are:

- high slope angles;
- adverse dipping of rock joints and bedding in conjunction with dip direction of the rock joints;
- high degree of weathering; and
- signs of previous slope movements.

No signs of mass instability such as hummocky ground, tension cracks or indicators of creep movement were noted during the inspection.

Photos of the site from our inspection are provided below and areas of note highlighted on **Figure 1**:

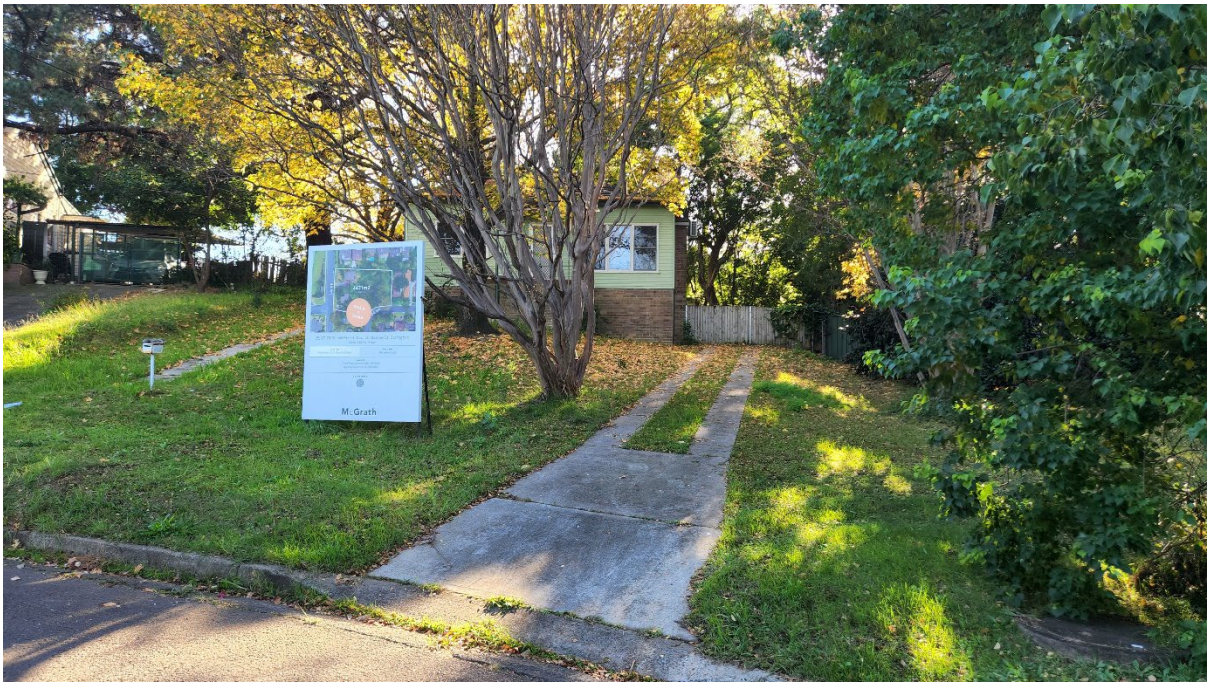


**Photo 1:** General view of site from Donald Street.

**Photo 2:** View of rear yard looking up slope towards the east.

**Photo 3:** View of rear yard looking towards the west.

**Photo 4:** View from Moseley Street looking towards the east.

### 3.1.1 Potential Slope Hazards

Morrow Geotechnics considers that structures and people at the site may be impacted by the following potential hazards:

**Hazard 1:** Large Failure within the natural slope at 8°
(8 m wide x 4 m high x 2 m deep approx. 64 $m^3$)

**Hazard 2:** Small slump within the natural slope at 8°
(2 m wide x 1 m high x 0.3 m deep approx. 0.6 $m^3$)

**Hazard 3:** Small Slump within excavations for the proposed excavation.
(3 m wide x 1 m high x 0.5 m deep approx. 1.5 $m^3$)

**Hazard 4:** Soil creep of surficial material across Shale Bedrock.

### 3.1.2 Assessed Risk Level for Property Damage

The risk zoning using property loss criteria in accordance with AGS 2007c is presented in **Table 2.**

**TABLE 2 SEMI-QUANTITATIVE ASSESSMENT FOR PROPERTY DAMAGE**

| Hazard | Likelihood (Indicative value of annual probability) | Consequence (Indicative Value) | Assessed Risk Level |
|---|---|---|---|
| **Hazard 1** | Barely Credible ($1 \times 10^{-6}$) | Major (60%) | **Very Low** |
| **Hazard 2** | Possible ($1 \times 10^{-3}$) | Insignificant (0.5%) | **Very Low** |
| **Hazard 3** | Possible ($1 \times 10^{-3}$) | Insignificant (0.5%) | **Very Low** |
| **Hazard 4** | Possible ($1 \times 10^{-3}$) | Insignificant (0.5%) | **Very Low** |

The risk zoning using property loss criteria in accordance with AGS 2007c is assessed to be **Very Low**.

### 3.1.3 Assessed Risk Level for Loss of Life

The risk zoning using loss of life criteria in accordance with AGS 2007c is presented in **Table 3.** Hazards have been assessed for current conditions and potential failure during remedial works assuming that no control measures are implemented during construction.

**TABLE 3 QUANTITATIVE ASSESSMENT FOR LOSS OF LIFE**

| Hazard | Annual Probability $P_{(H)}$ | Probability of Spatial Impact $P_{(IS:H)}$ | Temporal Spatial Probability $P_{(IS:H)}$ | Vulnerability of Individual $V_{(D:T)}$ | Annual Probability of Loss of Life $R_{(LoL)}$ |
|---|---|---|---|---|---|
| **Hazard 1** | $1 \times 10^{-6}$ | 1 | 1 | 0.1 | **$1 \times 10^{-7}$** |
| **Hazard 2** | $1 \times 10^{-3}$ | 1 | $1 \times 10^{-2}$ | $1 \times 10^{-2}$ | **$1 \times 10^{-7}$** |
| **Hazard 3** | $1 \times 10^{-3}$ | 0.1 | 0.1 | $1 \times 10^{-2}$ | **$1 \times 10^{-7}$** |
| **Hazard 4** | $1 \times 10^{-3}$ | $1 \times 10^{-2}$ | 0.1 | $1 \times 10^{-3}$ | **$1 \times 10^{-9}$** |

The assessed maximum risk to loss of life according to the quantitative risk assessment is $1 \times 10^{-7}$.

### 3.1.4 Assessed Risk Levels

The qualitative risk assessment indicates the site to have a **Very Low Risk** of damage to property as a result of the potential hazards identified. AGS Landslide Risk Management Concepts and Guidelines state that a assessed risk to property of Medium or greater as a very low risk has been established, no further investigations are required at this time.

The annual probability of loss of life for the person most at risk as a result of slope instability impacting the site is calculated to be less than $1 \times 10^{-7}$. The AGS Landslide Risk Management Concepts and Guidelines provide guidance on tolerable and acceptable loss of life risk for the person most at risk, indicating that a risk level of $1 \times 10^{-4}$ is typically considered tolerable for existing slopes while $1 \times 10^{-5}$ is typically acceptable for proposed developments. The AGS stipulates that the client, owner or, if appropriate, the regulator must carry out their own assessment to determine whether the low risk to property and damage is acceptable or tolerable.

### 3.1.5 Recommended Construction Procedures to Minimise Identified Risks

Morrow Geotechnics recommends the following measures are undertaken during construction in order to minimise the risks identified as part of the slope risk assessment:

- Any excavation work greater than 500 mm in depth must be inspected by a geotechnical engineer during excavations.
- Temporary batters are to be no steeper than 1H:1V. Permanent batters steeper than 2.5H:1V must be designed and supervised by an experienced geotechnical engineer.
- Surface water drainage is to be diverted away from any proposed excavation batter faces.
- Stormwater is to be discharged to the street and not allowed to infiltrate the existing slope or pond on site.

### 3.1.6 Risk Assessment Conclusions

The results of the risk assessment carried out as part of these works indicates that the slope in its current condition presents an acceptable risk to both life and property. Risk assessments have been carried out for both the subject site and for the impact of the slope on neighbouring sites. No further

remedial works at the site are required in order to make the batter safe from a geotechnical perspective.

## 3.2 AS2870 Site Classification

The site has been classified as Class 'H1' in accordance with AS2870:2011. The site classification has been provided on the basis that the performance expectations set out in Appendix B of AS2870–2011 are acceptable and that future site maintenance will be undertaken in accordance with CSIRO BTF 18.

## 3.3 Excavations and Shoring

### 3.3.1 Excavation Retention Design

Temporary batters may be considered for retention during excavation only where adequate room for full batter construction is available. Temporary batter slopes of 1V:1H will be possible for all units above the water table provided that surface water is diverted away from the batter faces and batter heights are kept to less than 4m. Where batters extend beyond 4 m height benching may be required and further advice should be sought from a qualified geotechnical engineer. Permanent batters of 2H:1V may be employed for excavation design above the water table. Permanent batters will require surface protection or revegetation to prevent erosion and slaking.

Where excavations extend beneath the zone of influence of nearby structures, services or pavements, or where site constraints do not allow the construction of temporary batters, basement retention will be required. For design of flexible shoring systems a triangular pressure distribution may be employed using the parameters provided in **Table 4**. For design of rigid anchored or braced walls, a trapezoidal earth pressure distribution should be used with a maximum pressure over the central 50% of the supported height of 0.65.Ka.γ.H (kPa), where 'H' is the effective vertical height of the wall in metres.

**TABLE 4 RETENTION DESIGN PARAMETERS**

| Material | | Unit 1 Topsoil / Fill | Unit 2 St-Vst Clay | Unit 3 Hard Clay | Unit 4 Class V Shale | Unit 5 Class IV Shale | Unit 6 Class III Shale |
|---|---|---|---|---|---|---|---|
| Earth Pressure Coefficients | At rest, $K_o$ | 0.53 | 0.5 | 0.46 | 0.44 | 0.38 | 0.33 |
| | Passive, $K_p$ | 2.77 | 3 | 3.39 | 3.54 | 4.20 | 5.04 |
| | Active, $K_a$ | 0.36 | 0.33 | 0.29 | 0.28 | 0.24 | 0.20 |
| Bulk Unit Weight ($kN/m^3$) | | 17 | 18 | 19 | 22 | 23 | 24 |

Earth pressure coefficients with **Table 4** are provided on the assumption that the ground behind the retaining wall is flat and drained. For cases where the ground profile rises at more than $5^o$ behind the retaining system detailed design input should be sought from a geotechnical engineer.

Surcharge loads on retention structures may either be modelled directly through finite element inputs in programs such as Plaxis or Wallap, or they may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level. The retaining walls should be designed to withstand hydrostatic pressure below the level of Unit 4 Sandstone unless permanent drainage is incorporated in the wall design.

### 3.3.2 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 5**. This assessment is based on available site investigation data and guidance on the assessment of excavatability of rock by Pettifer and Fookes (1994). The presence of medium to high strength bands in lower strength rock and the discontinuity spacing may influence the excavatability of the rock mass.

**TABLE 5 SOIL AND ROCK EXCAVATABILITY**

| Unit | Material | Excavatability |
|---|---|---|
| **1** | **Topsoil / Fill** | Easy digging by 20t Excavator |
| **2** | **St-Vst Clay** | |
| **3** | **Hard Clay** | |
| **4** | **Class V Shale** | Moderate ripping by 20t Excavator |
| **5** | **Class IV Shale** | Moderate ripping by 20t Excavator. Hydraulic hammering may be required where medium strength shale is encountered |
| **6** | **Class III Shale** | Hydraulic hammering will be required where medium strength or better Shale is encountered |

The excavation methodology may also be affected by the following factors:

- Scale and geometry of the excavation;
- Availability of suitable construction equipment;
- Potential reuse of material on site; and
- Acceptable excavation methods, noise, ground vibration and other environmental criteria.

### 3.3.3 Excavation Vibration Considerations

As a guide, safe working distances for typical items of vibration intensive plant are listed in **Table 6**. 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 6 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 |
| | < 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 6** 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 6** are given for guidance only. Monitoring of vibration levels may be required to ensure vibrations levels remain below threshold values during the construction period.

## 3.4 Groundwater Management

A regional groundwater table has not been encountered within the depth of borehole excavation. For any excavations at the site it should be expected that seepage water will be encountered at the soil/rock interface and in joints and bedding partings within the bedrock. Seepage in shale bedrock may be assumed as typically flowing downwards toward local drainage lines or regional water table, along horizontal bedding planes and sub-vertical joints. The rock mass permeability will be governed by the joints, faults and bedding planes.

## 3.5 Foundations

All proposed footings must found below Unit 1 material to prevent differential settlement on material of varying stiffness. 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 and elastic moduli.

The parameters given in **Table 7** may be used for the design of pad footings and bored piles.

**TABLE 7 FOUNDATION DESIGN PARAMETERS**

| Material | | Unit 1 Topsoil / Fill | Unit 2 St-Vst Clay | Unit 3 Hard Clay | Unit 4 Class V Shale | Unit 5 Class IV Shale | Unit 6 Class III Shale |
|---|---|---|---|---|---|---|---|
| Allowable Bearing Pressure (kPa) | | N/A | 150 | 250 | 700 | 1000 | 1500 |
| Ultimate Vertical End Bearing Pressure (kPa) | | N/A | 450 | 750 | 2100 | 3000 | 4500 |
| Elastic Modulus (MPa) | | 4 | 10 | 25 | 75 | 120 | 200 |
| Allowable Shaft Adhesion (kPa) | In Compression | 0 | 15 | 25 | 70 | 100 | 150 |
| | In Tension | 0 | 7.5 | 12.5 | 35 | 50 | 75 |

The bases of all foundation excavations must be 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. Side adhesion values provided in **Table 7** assume there is intimate contact between the pile and foundation material as specified in Pells (2004). Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678:2002 Earth Retaining Structures.

### 3.6 Limit State Design

For limit state design in accordance with AS2159 Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.65 may be expected.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable bearing pressures are provide for serviceability checks. These values have been determined to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing dimension.

## 4 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

Further geotechnical inspections should be carried out during construction to confirm the geotechnical and hydrogeological model. These should include:

- All excavated material transported off site should be classified in accordance with NSW EPA 2014 - Waste Classification Guideline Part 1; Classifying Waste.
- 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.

# 5 CONCLUSION

The site is suitable for the proposed development to be carried out provided that the recommendations of this report are incorporated into design and construction of the proposed works.

# 6 STATEMENT OF LIMITATIONS

The adopted investigation was limited by the agreed scope of the investigation. Further geotechnical inspections should be carried out during construction to confirm both the geotechnical model and the design parameters provided in this report.

Your attention is drawn to the document "Important Information", which is included in **Appendix B** 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 Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

# 7 REFERENCES

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

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

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

AS3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

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

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

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

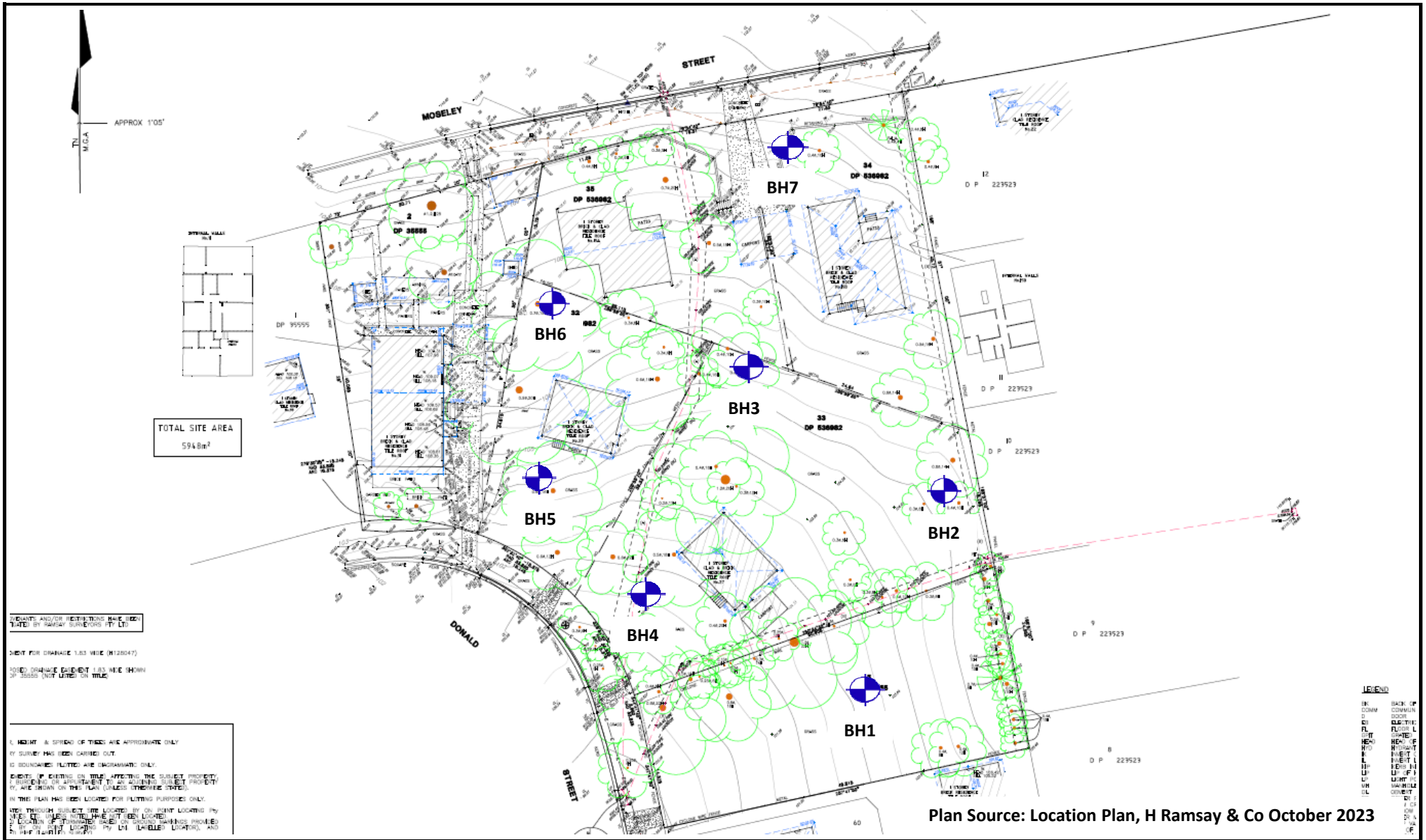
Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

# 8 CLOSURE

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,

Alan Morrow
Principal Geotechnical Engineer

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|---|---|---|---|
| morrow<br>79/6 Bellambi Lane, Bellambi NSW 2518<br>P: 0405 843 933 \| E: info@morrowgeo.com.au | Drawn | FM | **Captag Investments Pty Ltd**<br>**15a-15b Moseley Street & 25-31 Donald Street**<br>**Carlingford Nsw**<br>Geotechnical Investigation<br>Borehole Location Plan |
| | Approved | AM | |
| | Date | 21/11/2023 | |
| | Scale | NTS | |

Figure:
**1**

Project: P2914

Appendix A

# BOREHOLE LOGS AND EXPLANATORY NOTES

**Morrow Geotechnics**
Bellambi, NSW
Phone: 0405 843 933

# Engineering Log - Borehole

## Borehole No: BH1

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319373.3 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260841.9 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 101.58 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 4m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing: DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | GWNE | 2<br>3<br>3 | Topsoil | | CL | 0.3 | 101.58 | Topsoil silty CLAY (CL) : firm to stiff, low plasticity, dark grey, trace fine to medium grained sand, inorganic, w < pl, (trace rootlets). | F-St | w < PL | |
| | | 4<br>6<br>6<br>5<br>4<br>4<br>4<br>4 | Residual | | CI-CH | 0.5 | 101.08 | Residual silty CLAY (CI-CH) : stiff to very stiff, medium to high plasticity, light orange, with fine to medium sized gravel, inorganic, w < pl, (ironstone gravels, low resistance). | St-VSt | w < PL | |
| | | 6<br>19<br>25 | | | CI-CH | 1<br>1.3 | 100.58 | As above, but very stiff to hard, light grey, (low resistance). | VSt-H | w < PL | |
| | | | Rock | | SHA | 1.5 | 100.08 | Rock SHALE: distinctly weathered, very low to low strength, grey, fine grained, (low to medium resistance with clay bandings ). | VLS-LS | D | |
| | | | | | SHA | 2<br>2.5 | 99.58<br>99.08 | As above, but brown yellow. | VLS-LS | D | |
| | | | | | SHA | 3<br>3.5 | 98.58<br>98.08 | As above, but low strength, yellow brown dark grey, (medium resistance ). | LS | D | |
| | | | | | | 4 | 97.58 | **BH1 refusal at 4m (Practical Auger Refusal )** | | | |
| | | | | | | 4.5 | 97.08 | | | | |
| | | | | | | 5 | 96.58 | | | | |
| | | | | | | 5.5 | 96.08 | | | | |
| | | | | | | 6 | | | | | |

**Morrow Geotechnics**
Bellambi, NSW
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# Engineering Log - Borehole

## Borehole No: BH2

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319385.47999658826 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260869.456742899 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 104.28 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 4.6m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing: DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | Water Added | 3 | Topsoil | | CL | 0 | 104.28 | Topsoil silty CLAY (CL) : stiff, low plasticity, dark brown, with fine to medium sized gravel, trace fine to medium grained sand, inorganic, w < pl, (trace rootlets). | St | w < PL | |
| | | 3 | | | | 0.2 | | | | | |
| | | 6 | Residual | | CI-CH | | | Residual silty CLAY (CI-CH) : stiff to very stiff, medium to high plasticity, light orange, with fine to medium sized gravel, inorganic, w < pl, (ironstone gravels low resistance ). | St-VSt | w < PL | |
| | | 6 | | | | | | | | | |
| | | 6 | | | | 0.5 | 103.78 | | | | |
| | | 5 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 7 | | | | 1 | 103.28 | | | | |
| | | 7 | | | | 1.1 | | | | | |
| | | 12 | | | CI-CH | | | Residual silty CLAY (CI-CH) : hard, medium to high plasticity, light orange, with fine to medium sized gravel, inorganic, w < pl, (ironstone gravels low resistance ). | H | w < PL | |
| | | 16 | | | | 1.4 | | | | | |
| | | 25 | Rock | | LAM | 1.5 | 102.78 | Rock LAMINITE: distinctly weathered, very low to low strength, brown yellow, fine grained, (low resistance with clay bandings ). | VLS-LS | D | |
| | | | | | | 2 | 102.28 | | | | |
| | | | | | SHA | | | Rock SHALE: distinctly weathered, very low to low strength, grey, fine grained, (low resistance ). | VLS-LS | D | |
| | | | | | | 2.5 | 101.78 | | | | |
| | | | | | | 3 | 101.28 | | | | |
| | | | | | SHA | | | As above, but black, (low to medium resistance ). | VLS-LS | D | |
| | | | | | | 3.5 | 100.78 | | | | |
| | | | | | | 4 | 100.28 | | | | |
| | | | | | SHA | | | As above, but low strength, (medium to high resistance ). | LS | D | |
| | | | | | | 4.5 | 99.78 | | | | |
| | | | | | | | | **BH2 refusal at 4.6m (Practical Auger Refusal )** | | | |
| | | | | | | 5 | 99.28 | | | | |
| | | | | | | 5.5 | 98.78 | | | | |
| | | | | | | 6 | | | | | |

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# Engineering Log - Borehole

## Borehole No: BH3

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319367.61566097924 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260884.514089575 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 104.17 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 4.5m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing: DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | GWNE | 2 | Topsoil | | CL | | 104.17 | Topsoil silty CLAY (CL) : stiff, low plasticity, dark brown, with fine to medium grained sand, inorganic, w < pl, (trace rootlets). | St | w < PL | |
| | | 2 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | 0.4 | | | | | |
| | | 5 | Residual | | CI-CH | 0.5 | 103.67 | Residual silty CLAY (CI-CH) : very stiff, medium to high plasticity, mottled red orange, with fine to medium sized gravel, inorganic, w < pl, (ironstone gravels, low resistance). | VSt | w < PL | |
| | | 8 | | | | | | | | | |
| | | 6 | | | | | | | | | |
| | | 6 | | | | | | | | | |
| | | 7 | | | | | | | | | |
| | | 8 | | | | 1 | 103.17 | | | | |
| | | 13 | | | CI-CH | | | As above, but hard, orange red grey. | H | w < PL | |
| | | 17 | | | | | | | | | |
| | | 12 | | | | | | | | | |
| | | 25 | | | | 1.5 | 102.67 | | | | |
| | | | Rock | | ARG | | | Rock LAMINITE: distinctly weathered, very low to low strength, brown yellow, fine to medium grained, (low resistance with clay bandings ). | VLS-LS | D | |
| | | | | | | 2 | 102.17 | | | | |
| | | | | | | 2.5 | 101.67 | | | | |
| | | | | | | 3 | 101.17 | | | | |
| | | | | | ARG | | | As above, but dark brown, (low to medium resistance ). | VLS-LS | D | |
| | | | | | | 3.5 | 100.67 | | | | |
| | | | | | | 4 | 100.17 | | | | |
| | | | | | | 4.2 | | | | | |
| | | | | | SHA | | | Rock SHALE: distinctly weathered, low strength, dark grey, fine grained, (medium to high resistance). | LS | D | |
| | | | | | | 4.5 | 99.67 | **BH3 refusal at 4.5m (Practical Auger Refusal)** | | | |
| | | | | | | 5 | 99.17 | | | | |
| | | | | | | 5.5 | 98.67 | | | | |
| | | | | | | 6 | | | | | |

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# Engineering Log - Borehole

## Borehole No: BH4

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319360.4322945556 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260858.915390445 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 101.3 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 5m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing: DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | 2 | Fill | | CL | | 101.3 | Fill silty CLAY (CL) : stiff, low plasticity, very dark grey, trace fine sized gravel, trace fine to medium grained sand, inorganic, (trace rootlets). | St | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 3 | | | | 0.4 | | | | | |
| | | 3 | Residual | | CI-CH | 0.5 | 100.8 | Residual silty CLAY (CI-CH) : firm to stiff, medium to high plasticity, mottled orange red, with fine sized gravel, inorganic, w < pl, (ironstone gravels). | F-St | w < PL | |
| | | 2 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 2 | | | | 1 | 1 100.3 | | | | |
| | | 3 | | | CI-CH | | | As above, but stiff, purple, with fine to medium sized gravel. | St | w < PL | |
| | | 3 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 4 | | | | 1.5 | 99.8 | | | | |
| | | 4 | | | | | | | | | |
| | | 3 | | | | 1.7 | | | | | |
| | | 3 | | | CI-CH | | | As above, but red-purple, (light iron staining). | St | w < PL | |
| | | 3 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | 2 | 99.3 | | | | |
| | | 4 | | | | 2.2 | | | | | |
| | | 19 | | | CI-CH | | | Residual silty CLAY (CI-CH) : hard, medium to high plasticity, red purple, with fine sized gravel, inorganic, w < pl, (ironstone gravels). | H | w < PL | |
| | | 12 | | | | | | | | | |
| | | 12 | | | | 2.5 | 98.8 | | | | |
| | | 14 | | | | | | | | | |
| | | 25 | | | | 2.7 | | | | | |
| | | | Rock | | SHA | | | Rock SHALE: distinctly weathered, very low to low strength, brown yellow, fine grained, (low resistance with some clay bandings). | VLS-LS | D | |
| | | | | | | 3 | 98.3 | | | | |
| | | | | | | 3.5 | 97.8 | | | | |
| | | | | | | 4 | 4 97.3 | | | | |
| | Water Added | | | | SHA | | | As above, but (medium resistance). | VLS-LS | D | |
| | | | | | | 4.5 | 96.8 | | | | |
| | | | | | | 4.7 | | | | | |
| | | | | | SHA | | | As above, but low strength, dark grey, (medium to high resistance). | LS | D | |
| | | | | | | 5 | 96.3 | **BH4 refusal at 5m (Practical Auger Refusal)** | | | |
| | | | | | | 5.5 | 95.8 | | | | |
| | | | | | | 6 | | | | | |

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# Engineering Log - Borehole

## Borehole No: BH5

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319340.6129622836 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260868.656858366 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 103.41 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 4.5m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing: DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | 3 | Residual | | CI-CH | | 103.41 | Residual silty CLAY (CI-CH) : stiff to very stiff, medium to high plasticity, mottled orange red, with fine to medium sized gravel, inorganic, w < pl, (ironstone gravels). | St-VSt | w < PL | |
| | | 3 | | | | 0.5 | 102.91 | | | | |
| | | 6 | | | | 0.7 | | | | | |
| | | 6 | | | CI-CH | | | As above, but mottled light orange light grey. | St-VSt | w < PL | |
| | | 6 | | | | 1 | 102.41 | | | | |
| | | 6 | | | | 1.3 | | | | | |
| | | 6 | | | CI-CH | | | As above, but very stiff to hard, mottled light grey, (light laminate bands). | VSt-H | w < PL | |
| | | 6 | | | | 1.5 | 101.91 | | | | |
| | | 8 | | | | 1.8 | | | | | |
| | | 9 | | | CI-CH | | | As above, but (light laminate bands). | VSt-H | w < PL | |
| | | 11 | | | | 2 | 101.41 | | | | |
| | | 25 | | | | 2.5 | 100.91 | | | | |
| | | | | | | 2.7 | | | | | |
| | | | Rock | | LAM | | | Rock LAMINITE: distinctly weathered, very low to low strength, brown yellow, fine grained, (low resistance ). | VLS-LS | D | |
| | | | | | | 3 | 100.41 | | | | |
| | | | | | | 3.5 | 99.91 | | | | |
| | Water Added | | | | | 4 | 99.41 | | | | |
| | | | | | SHA | 4 | | Rock SHALE: distinctly weathered, low strength, black, fine grained, (medium to high resistance). | LS | D | |
| | | | | | | 4.5 | 98.91 | | | | |
| | | | | | | | | **BH5 refusal at 4.5m (Practical Auger Refusal)** | | | |
| | | | | | | 5 | 98.41 | | | | |
| | | | | | | 5.5 | 97.91 | | | | |
| | | | | | | 6 | | | | | |

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# Engineering Log - Borehole

## Borehole No: BH6

| | | | | | |
|---|---|---|---|---|---|
| UTM | : 56H | Driller Rig | : Trailer Mounted ADT | Job Number | : P2914 |
| Easting | : 319339.00922419934 | Driller Supplier | : Tony Smith | Client | : Captag Investments Pty Ltd |
| Northing | : 6260891.332922885 | Logged By | : Feby Markose | Project | : Carlingford, NSW |
| RL | : 106.56 | Reviewed By | : Mark Peach | Location | : 15A Moseley Street, Carlingford NSW |
| Total Depth | : 4.8m | Date | : 30/05/2023 | | |

| Drilling Method | Water | Testing DCP | Soil Origin | Graphic Log | Classification Code | Depth (m) | Elevation (m) | Material Description | Consistency | Moisture | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | Residual | | CI-CH | | 106.56 | Residual silty CLAY (CI-CH) : stiff to very stiff, medium to high plasticity, mottled orange red, with medium to coarse sized gravel, inorganic, w < pl, (ironstone and shale gravels ). | St-VSt | w < PL | |
| | | 8 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| | | 6 | | | | | | | | | |
| | | 5 | | | | 0.5 | 106.06 | | | | |
| | | 6 | | | | | | | | | |
| | | 6 | | | | | | | | | |
| | | 7 | | | | 0.8 | | | | | |
| | | 8 | | | CI-CH | | | As above, but very stiff to hard, mottled light orange light grey, with fine to medium sized gravel, (light ironstone bands). | VSt-H | w < PL | |
| | | 8 | | | | 1 | 105.56 | | | | |
| | | 8 | | | CI-CH | | | As above, but mottled red grey, (low resistance with iron staining). | VSt-H | w < PL | |
| | | 9 | | | | | | | | | |
| | | 8 | | | | | | | | | |
| | | 10 | | | | | | | | | |
| | | 11 | | | | 1.5 | 105.06 | | | | |
| | | 25 | | | | 1.6 | | | | | |
| | | | Rock | | LAM | | | Rock LAMINITE: distinctly weathered, very low to low strength, brown yellow, fine grained, (low resistance with clay bandings). | VLS-LS | D | |
| | | | | | | 2 | 104.56 | | | | |
| | | | | | | 2.5 | 104.06 | | | | |
| | Water Added | | | | LAM | | | Rock LAMINITE: distinctly weathered, very low to low strength, very dark grey, fine grained, (low to medium resistance ). | VLS-LS | D | |
| | | | | | | 3 | 103.56 | | | | |
| | | | | | | 3.5 | 103.06 | | | | |
| | | | | | | 4 | 102.56 | | | | |
| | | | | | | 4.3 | | | | | |
| | | | | | LAM | | | As above, but low strength, black, (medium to high resistance). | LS | D | |
| | | | | | | 4.5 | 102.06 | | | | |
| | | | | | | | | **BH6 refusal at 4.8m (Practical Auger Refusal)** | | | |
| | | | | | | 5 | 101.56 | | | | |
| | | | | | | 5.5 | 101.06 | | | | |
| | | | | | | 6 | | | | | |

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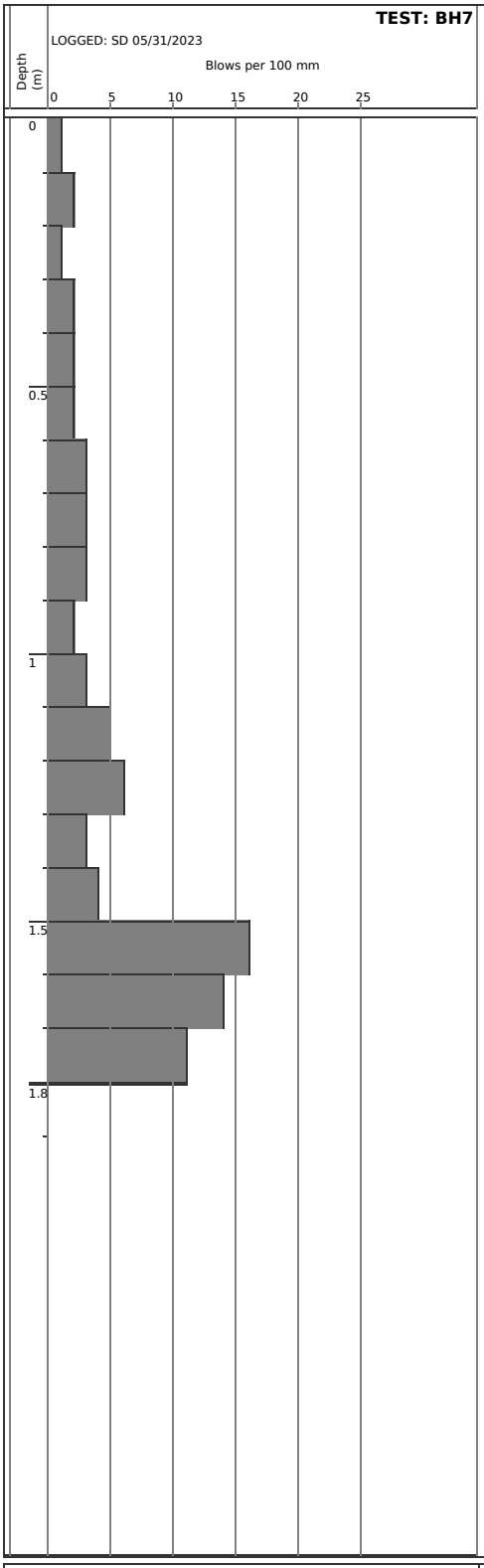
| | | | |
|---|---|---|---|
| CLIENT | : Captag Investments Pty Ltd | | SHEET : 1 OF 1 |
| CONTRACTOR | : Morrow Geotechnics | | |
| PROJECT | : Carlingford, NSW | | |
| LOCATION | : 15A Moseley Street, Carlingford NSW | | |
| PROJECT No. | : P2914 | | |

**TEST: BH7**

LOGGED: SD 05/31/2023




Comments

# Soil and Rock Logging Explanatory Notes

## GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

## DRILLING

**Drilling & Casing**

| | |
|---|---|
| ADV | Auger Drilling with V-Bit |
| ADT | Auger Drilling with TC Bit |
| WB | Wash-bore drilling |
| RR | Rock Roller |
| NMLC | NMLC core barrel |
| NQ | NQ core barrel |
| HMLC | HMLC core barrel |
| HQ | HQ core barrel |

**Drilling Fluid/Water**

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

**Drilling Penetration/Drill Depth**

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

| | |
|---|---|
| VE | Very Easy |
| E | Easy |
| M | Medium |
| H | High |
| VH | Very High |

**Groundwater Levels**

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

| | |
|---|---|
| D | Disturbed |
| B | Bulk |
| U | Undisturbed |
| SPT | Standard Penetration Test |
| N | Result of SPT (sample taken) |
| PBT | Plate Bearing Test |
| PZ | Piezometer Installation |
| HP | Hand Penetrometer Test |

## EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

**MATERIAL DESCRIPTION - SOIL**

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

**Moisture Condition**

| | |
|---|---|
| D | Dry, looks and feels dry |
| M | Moist, No free water on remoulding |
| W | Wet, free water on remoulding |

Consistency - In accordance with AS 1726-1993, Appendix A2.5

| | | |
|---|---|---|
| VS | Very Soft | < 12.5 kPa |
| S | Soft | 12.5 – 25 kPa |
| F | Firm | 25 – 50 kPa |
| St | Stiff | 50 – 100 kPa |
| VSt | Very Stiff | 100 – 200 kPa |
| H | Hard | > 200 kPa |

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

| | | |
|---|---|---|
| VL | Very Loose | < 15 % |
| L | Loose | 15 – 35 % |
| MD | Medium Dense | 35 – 65 % |
| D | Dense | 65 – 85 % |
| VD | Very Dense | > 85 % |

## MATERIAL DESCRIPTION -ROCK

**Material Description**

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

**Core Loss**

Is shown at the bottom of the run unless otherwise indicated.

**Bedding**

| | |
|---|---|
| Thinly Laminated | < 6 mm |
| Laminated | 6 - 20 |
| Very Thinly Bedded | 20 - 60 |
| Thinly Bedded | 60 - 200 |
| Medium Bedded | 200 – 600 |
| Thickly Bedded | 600 – 2000 |
| Very Thickly Bedded | > 2000 |

**Weathering** - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

| | |
|---|---|
| Fresh (F) | Rock substance unaffected by weathering |
| Slightly Weathered (SW) | Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable. |
| Moderately Weathered (MW) | Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable. |
| Highly Weathered (HW) | Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained. |
| Extremely Weathered (EW) | Rock texture evident but material has soil properties and can be remoulded. |

**Strength** - The following terms are used to described rock strength:

| Rock Strength Class | Abbreviation | Point Load Strength Index, Is(50) (MPa) |
|---|---|---|
| Extremely Low | EL | < 0.03 |
| Very Low | VL | 0.03 to 0.1 |
| Low | L | 0.1 to 0.3 |
| Medium | M | 0.3 to 1 |
| High | H | 1 to 3 |
| Very High | VH | 3 to 10 |
| Extremely High | EH | ≥ 10 |

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

° Diametral Point Load Test

Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

## MATERIALS STRUCTURE/FRACTURES

**ROCK**

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

| | | |
|---|---|---|
| Defects | ——— | Defects open in-situu or clay sealed |
| | – – – – – | Defects closed in-situ |
| | ..... | Breaks through rock substance |

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Orientation - angle relative to the plane normal to the core axis.

| | | |
|---|---|---|
| Type | BP | Bedding Parting |
| | JT | Joint |
| | SM | Seam |
| | FZ | Fracture Zone |
| | SZ | Shear Zone |
| | VN | Vein |
| | FL | Foliation |
| | CL | Cleavage |
| | DL | Drill Lift |
| | HB | Handling Break |
| | DB | Drilling Break |
| Infilling | CN | Clean |
| | X | Carbonaceous |
| | Clay | Clay |
| | KT | Chlorite |
| | CA | Calcite |
| | Fe | Iron Oxide |
| | Qz | Quartz |
| | MS | Secondary Mineral |
| | MU | Unidentified Mineral |
| Shape | PR | Planar |
| | CU | Curved |
| | UN | Undulose |
| | ST | Stepped |
| | IR | Irregular |
| | DIS | Discontinuous |
| Rougness | POL | Polished |
| | SL | Slickensided |
| | S | Smooth |
| | RF | Rough |
| | VR | Very Rough |

**SOIL**

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

Appendix B

# IMPORTANT INFORMATION

# Important Information

This Document has been provided by Morrow Geotechnics Pty Ltd subject to the following limitations:

This Document has been prepared for the particular purpose outlined in Morrow Geotechnics' proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of Morrow Geotechnics' Services are as described in Morrow Geotechnics' proposal, and are subject to restrictions and limitations. Morrow Geotechnics did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. The scope of services may have been limited by such factors as time, budget, site access or other site conditions. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Morrow Geotechnics in regards to it. Any advice given within this document is limited to geotechnical considerations only. Other constraints particular to the project, including but not limited to architectural, environment, heritage and planning matters may apply and should be assessed independently of this advice.

Conditions may exist which were undetectable given the limited nature of the enquiry Morrow Geotechnics was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required. No geotechnical investigation can provide a full understanding of all possible subsurface details and anomalies at a site.

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