

GEOTECHNICAL INVESTIGATION & ACID SULFATE SOIL (ASS) ASSESSMENT

FOR

HOMES NSW

776, 792 – 794 Botany Road & 33 – 37 Henry Kendall Crescent, Mascot (BGWHL)

Report No: 24/0856A

Project No: 32630/8546D-G

October 2024

Table of Contents

DOCUMENT CONTROL.....	2
1. INTRODUCTION	3
2. NATURE OF THE INVESTIGATION	5
2.1. Fieldwork	5
2.2. Laboratory Testing.....	6
3. GEOLOGY AND SITE CONDITIONS.....	6
4. SUBSURFACE CONDITIONS	7
4.1. Stratigraphy	7
4.2. Groundwater Observation.....	9
5. GEOTECHNICAL DISCUSSION	9
5.1. Site Classification to AS2870-2011	9
5.2. Earthquake Site Classification to AS1170.4-2007	10
5.3. Excavation Conditions and Monitoring	10
5.4. Excavation Retention.....	11
5.5. Excavation Adjacent to RMS Assets.....	12
5.6. Retaining Wall Design Parameters	12
5.7. Foundation Design.....	14
5.8. Groundwater Considerations	14
5.9. Soil Aggressiveness	14
6. ACID SULFATE ASSESSMENT	15
6.1. Introduction.....	15
6.2. Presence of ASS	16
6.3. Assessment.....	16
6. FINAL COMMENTS.....	21

DRAWING NO. 24/0856 – BOREHOLE AND PENETROMETER LOCATIONS

NOTES RELATING TO GEOTECHNICAL REPORTS

APPENDIX A – BOREHOLE LOGS AND EXPLANATION SHEETS, CORE PHOTOGRAPHS AND POINT
 LOAD TEST RESULTS

APPENDIX B – LABORATORY TEST RESULTS

DOCUMENT CONTROL

REPORT TITLE: Geotechnical Investigation

REPORT NO: 24/0856A

Revision	Details	Date	Amended By
0	Original	April 29, 2024	LL
A	Revision	October 17, 2024	LL

Following advice from the Building Commissioner, the advice, recommendations, and design parameters provided in this report are only valid and to be relied upon if geotechnical inspections of footings and support/shoring systems are conducted by STS Geotechnics during construction.

© 2024 STS GEOTECHNICS (STS) ABN: 45 636 179 729

This report is protected by copyright law and may only be reproduced, in electronic or hard copy format, if it is copied and distributed in full and with prior written permission by STS.

1. INTRODUCTION

This updated combined Geotechnical Investigation and Acid Sulfate Soils (ASS) assessment has been prepared by STS Geotechnics Pty Ltd on behalf of Homes NSW for a State Significant Development Application (SSD-72393459) for construction of a residential flat building ranging in height between three and eight storeys with a total of 126 social and affordable housing apartments at 792-794 Botany Road and 33-37 Henry Kendal Crescent, Mascot.

The purpose of this Geotechnical Investigation Report is to present the results and recommendations of the geotechnical investigation and ASS assessment, and to address the Secretary's Environmental Assessment Requirements (SEARs) for the project issued on 24 July 2024 which identified the following specific assessment requirements:

SEAR 13. Ground and Water Conditions:

- Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils.
- Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on:
 - surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.
 - groundwater resources in accordance with the relevant Groundwater Guidelines.

The site is located at 792-794 Botany Road and 33-37 Henry Kendal Crescent, Mascot and is located within Bayside Local Government Area (LGA).

The site has a total site area of 4,904 square metres (sqm) and has three street frontages; Henry Kendall Crescent to the west, Coward Street to the south and Botany Road to the east.

The site comprises 25 social housing dwellings within five two storey brick buildings including three walkup apartments buildings and two town house style buildings which were constructed in the 1960s. There are a number of mature street trees located along Botany Road, Coward Street and Henry Kendall Crescent. Refer to Figure 1.

The site is located opposite Mascot Memorial Park on Coward Street, a large public park which provides a range of passive and active recreation, including children's playground, formal gardens, and tennis courts.

The site is accessible by public transport (buses and trains) with frequent bus services that run along Botany Road. Mascot Train Station is also located within 850m of the site.



Figure 1: Location of the subject site

The proposed development comprises demolition of existing buildings and construction of a residential flat building ranging in height between three and eight storeys to accommodate 126 social and affordable housing apartments, a communal room and on grade car parking including tree removal, associated landscaping and public domain works. A site plan is attached, drawing no. 24/0856.

The following documents were provided to assist with the preparation of this report:

- Acid Sulfate Soils Management Plan prepared by EI Australia, Project No. E26416.E14_Rev0, dated 11 June 2024.
- Architectural Drawings prepared by SJB Architects, Job No 6956 Revision 5 dated 17.09.2024.
- Civil Drawing (SSDA) Prepared by Mott Macdonald, 1034 19-MMD-MAS-XX DR-C-0001, Revision 3 dated 14/10/2024.
- Integrated Water Management Plan prepared by Mott MacDonald, Reference 7031034 19-001 {01} revision C dated 14 October 2024.
- Detailed Site Investigation (DSI) Report prepared by Alliance Geotechnical Pty Ltd, Report No. 17716.3-ER-1-1, Rev. 2, dated 10/10/2024.
- Remedial Action Plan (RAP) prepared by Alliance Geotechnical Pty Ltd, Report No. 17716.3-ER-1-2 Rev 1, dated 10/10/2024.
- Geotechnical Investigation Report prepared by Alliance Geotechnical Pty Ltd, Report No. 17716.3-GR-1-1 Rev A, dated 15/10/2024.

There is no basement excavation, however, minor deeper excavations may be required for footings and/ or service trenches. If excavations are carried out, advice regarding potential excavation conditions and retention are provided. Reference to the Bayside Council LEP indicates that the site is located within a Class 4 Acid Sulfate Soils (ASS) area. In Class 4 areas

“works more than 2 metres below the natural ground surface and works by which the water table is likely to be lowered more than 2 metres below the natural ground surface” require assessment. Therefore, an ASS assessment has been carried out.

The purpose of the investigation was to provide information on:

- Subsurface conditions including groundwater levels,
- Site Classification to AS2870-2011,
- Site classification for earthquake design in accordance with AS 1170.4,
- Excavation conditions and monitoring (if required),
- Temporary and permanent excavation support (if required),
- Retaining wall design parameters (if required),
- Excavation adjacent to RMS assets (if required),
- Groundwater considerations,
- Foundation design parameters including foundation options,
- Exposure classification/soil aggressivity in accordance with AS2870-2011 & AS2159-2009,
- WALLAP/PLAXIS design parameters for all materials encountered, and
- ASS assessment and need for an ASS Management Plan.

The investigation was undertaken in accordance with STS proposal ref. P24-053B dated February 21, 2024. Because of the depth to rock, the drilling program was modified with the agreement of Homes NSW.

2. NATURE OF THE INVESTIGATION

2.1. Fieldwork

The fieldwork consisted of drilling five (5) boreholes numbered BH1 to BH5, inclusive, at the locations shown on Drawing No. 24/0856. BH2 and BH3 were drilled using a track mounted Commachio Geo 305 drilling rig, and BH1, BH4, and BH5, were drilled using a track mounted Commachio Geo 205 drilling rig, owned, and operated by Terratest and GeoSense Drilling Engineers, respectively. The boreholes were drilled using a solid flight auger until groundwater was encountered, and then continued using wash boring. In BH2, BH3, and BH5, were wash bored to depths of 27.7 to 34 mBEGl, and then extended with NMLC coring to depths of about 34.5 to 37.14 mBEGl. Soil strengths were determined by undertaking Standard Penetration Test (SPT) tests at the borehole locations at selected depths. A Sparkfun RTK Global Positioning Service (GPS) device was utilised to determine the co-ordinates and approximate ground surface elevations of each borehole. To measure the groundwater level, monitoring wells were installed in BH1 and BH5.

The recovered cores were boxed on site and transported to the STS laboratory where the cores were logged, photographed, and point load tested.

The subsurface conditions observed are recorded on the borehole logs given in Appendix A together with photographs of the recovered rock core. An explanation of the terms used on the logs is also given in Appendix A. Notes relating to geotechnical reports are also given in Appendix A.

2.2. Laboratory Testing

To assess the soil for its aggressiveness, five (5) selected representative soil samples were tested to determine the following:

- pH,
- Sulphate content (SO₄),
- Chloride (Cl)
- Electrical Conductivity (EC), and

Based on field observations, six (6) representative soil samples were selected for laboratory analysis for the Acid Sulfate Soils assessment. The samples were dispatched to Australian Laboratory Services (ALS) for analysis using the Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) method. The method allows both a measure of the existing and potential acidity.

To assess the rock strength, selected representative rock core samples were tested to determine the Point Load Index.

The detailed test reports have been attached in Appendix B.

3. GEOLOGY AND SITE CONDITIONS

The Sydney geological series at a scale of 1:100,000 shows the site is underlain by Quaternary Age soils comprising medium to fine grained “marine” sand with podsols. These sands were deposited as transgressive dunes.

The site is rectangular in shape with an area of about 1748 m². At the time of the fieldwork, the site was occupied by residential apartment blocks and an NSW Ambulance facility. Site vegetation comprises grass, trees, and shrubs. The ground surface falls about 0.3 metres to the south-west across the site.

The site is bound by Henry Kendall Crescent to the west, Coward Street to the south, Botany Road to the east, and residential dwellings in the other adjoining properties.

4. SUBSURFACE CONDITIONS

4.1. Stratigraphy

When assessing the subsurface conditions across a site from a limited number of boreholes, there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour regarding the proposed development. The actual condition at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies, particularly on a site that has been previously developed.

Based on our observations, the stratigraphy has been grouped into six (6) major geotechnical units. A summary of the subsurface conditions is presented in Table 4.1. More detailed descriptions of subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**. The details of the methods of rock classifications, explanatory notes and abbreviations adopted on the borehole logs are also presented in **Appendix A**.

Table 4.1 – Stratigraphy Summary

Unit	Material	Depth to Top of Unit ¹ (mBEGl)	RL of Top of Unit ¹ (mAHD)	Observed Thickness (m)	Comments
1	Topsoil	0.0	8.0 to 8.4	0.2 to 0.5	Silty sand, dark brown, fine to medium grained, with rootlets.
2	Very Loose (VL) to Loose (L) to Medium Dense (MD) Silty Sands and Clayey Sands	0.2 to 0.5	7.5 to 8.0	4.0 to 5.8	Grey, brown, yellow, orange, fine to medium grained sand. Black organic sandy silt, and reddish brown silty sand layers with sulphurous odour, in BH1 and BH5, respectively.
3	Dense (D) Silty Sands and Clayey Sands	4.5 to 6.0	2.2 to 3.9	14.0 to 17.0	Grey, brown, yellow, orange, fine to medium grained sand.
4	Very Stiff (VSt) to Hard (H) Sandy Clay and Silty Clay	19.5 to 21.5	-11.5 to -13.2	7.1 to 10.0	Grey, brown, low to high plasticity.
5	Sandstone (Class V)	28.5 to 30.0	-20.3 to -21.7	4.0 to 5.0	Extremely weathered, grey, brown, fine to medium grained.
6	Sandstone (Class III)	33.2 to 34.0	-25.0 to -25.7	n/a	Distinctly weathered to fresh, grey, brown, fine to medium grained, medium to thickly bedded, medium to high strength. Only encountered in BH2, BH3, and BH5.

Notes:

- 1 Approximate depth below existing ground level and RLs at the time of our assessment, depths and levels may vary across the site.

4.2. Groundwater Observation

Groundwater was observed in the in the boreholes during the site drilling and the observations are summarised in Table 4.2.

Table 4.2 – Borehole Groundwater Observations

Location	Date of Measurement	Depth (mBEGl)	RL (mAHD)
BH1	03/04/2024	1.8	6.2
BH2	09/04/2024	1.2	7.0
BH3	10/04/2024	1.2	7.0
BH4	05/04/2024	1.7	6.8
BH5	18/03/2024	1.8	6.7

Following the completion of drilling, groundwater monitoring wells were installed in BH1 and BH5 and each were bailed continuously for up to 15 minutes. Water circulation used in the boreholes during coring prevented observations of groundwater levels during and immediately following drilling operations. A secondary site visit was carried out to measure the monitoring wells and the results are summarised in Table 4.3.

Table 4.3 – Groundwater Monitoring Well Measurements

Location of Well	Date of Secondary Site Visit	Depth (m)BEGl	RL (mAHD)
BH1	22/04/2024	1.5	6.5
BH5	22/04/2024	1.5	6.8

5. GEOTECHNICAL DISCUSSION

5.1. Site Classification to AS2870-2011

The classification has been prepared in accordance with the guidelines set out in the “Residential Slabs and Footings” Code, AS2870 - 2011.

Because of the presence of low strength soils, the site is classified as a *Problem Site (P)*. It is not considered appropriate to reclassify this site.

Foundation design and construction consistent with this classification shall be adopted as specified in the above referenced standard and in accordance with the following design details.

5.2. Earthquake Site Classification to AS1170.4-2007

The classification has been prepared in accordance with the guidelines set out in the “Earthquake actions in Australia” Code, AS1170 Part 4, 2007:

- An earthquake subsoil class of Class De (Deep Soil)
- The hazard factor (z) for Sydney is 0.09

5.3. Excavation Conditions and Monitoring

The following advice in sections 5.3 to 5.6, inclusive, have been reproduced from the previous report in the event that excavations are carried out. We understand the design has been updated so there are no basements proposed. Conventional earthmoving excavators without assistance should be able to remove the soils for minor trenches or minor excavations.

When excavations are carried out, consideration should be made to the impact of the proposed development upon neighbouring structures, roadways, and services. Any excavation retention systems should be designed to limit lateral deflections.

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

- Limit lateral deflection of temporary or permanent retaining structures;
- Limit vertical settlements of ground surface at common property boundaries and services easement; and
- Limit Peak Particle Velocities (PPV) from vibrations, caused by construction equipment or excavation, experienced by any nearby structures and services.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations / services/ pavements and other structures located within or near the zone of influence of the excavation. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructures. Measurements should be taken in the following sequence:

- Before commencing installation of retaining structures where appropriate to determine the baseline readings. Two independent sets of measurements must be taken confirming measurement consistency;
- After installation of the retaining structures, but before commencement of excavation;
- After excavation to the first row of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to any subsequent rows of supports or anchors, but prior to installation of these supports or anchors;

- After excavation to the base of the excavation;
- After de-stressing and removal of any rows of supports or anchors; and
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the latter.

It would be appropriate before commencing excavation to undertake a dilapidation survey of any adjacent structures that may potentially be damaged. This will provide a reasonable basis for assessing any future claims of damage.

5.4. Excavation Retention

It is of course important that the onsite excavations are adequately always supported and do not endanger the adjacent properties.

If excavations are proposed which extend below the water table, it will be necessary to ensure the perimeter support is watertight to prevent water flow into the excavation. In this regard, a secant pile wall is an appropriate method of support because it is watertight. A contiguous pile wall will not be suitable because of the difficulty of sealing off the zone between the piles. The water flow entering the excavation between the piles will bring with it sand from outside the excavation. This could result in the loss of foundation support and damage to buildings in the adjoining properties.

In this regard, a secant pile wall is considered the appropriate method of support. Sheet pile walls are normally too permeable to use for this purpose, however, when combined with shotcrete they can be suitable. When installing sheet piles, the effects of vibrations during installation need to be considered.

Council and the NSW Department of Primary Industries (DPI) do not allow permanent dewatering. Temporary dewatering for construction purposes is normally allowed provided it is properly designed and managed to ensure that the likely drawdown will have no adverse impact on adjoining structures/infrastructures. If a secant pile system is used, a one-off removal of ground water from the excavated area will be required, therefore, a licence for dewatering may potentially not be required.

Typically, a cut-off wall would be socketed to a relatively low permeable stratum to limit groundwater drawdown, and this is the most effective method. However, given the presence of deep bedrock up to a depth of 30m BEGL, using a cut-off wall installed to bedrock would be an expensive option. However, a consistent clay layer at about 21m was observed and cut-off wall at these depths may be feasible. However, long term monitoring and detailed seepage analysis after the final designs are known to confirm the performance of the cut-off wall design.

A detailed monitoring program should be implemented to identify the risks and trigger levels decided for when the contingency measures need to be taken.

5.5. Excavation Adjacent to RMS Assets

Reference should be made to the TfNSW Technical Direction – Geotechnology (GTD) 2020/001, Version No.01, dated 2 July 2020, with regards to excavation/shoring (if required) adjacent to Botany Road, Henry Kendell Crescent, and Coward Street. This document outlines requirements for excavations adjacent to RMS infrastructure and includes the level of geotechnical investigation required, dilapidation surveying, instrumentation and monitoring during construction, trigger levels and contingency plans.

Instrumentation (e.g. inclinometers) and monitoring is typically required where the excavation exceeds 3 m in height (for cantilevered shoring walls) or 6 m in height (for anchored or propped shoring walls).

As the proposed development does not have a basement excavation, further analysis including numerical modelling is not considered to be necessary.

5.6. Retaining Wall Design Parameters

The parameters used to proportion retaining wall support depends on whether the walls can be permitted to deflect. For walls, which cannot be permitted to deflect, an at rest earth pressure coefficient (K_0) should be adopted for the soils. For walls that can be allowed to deflect, an active earth pressure coefficient (K_a) should be adopted for the soils. The recommended earth pressure coefficients have been given in Table 5.1. As with all retaining walls, allowance must be made to the earth pressure coefficients for ground surface slope, presence of groundwater and surcharge loads.

It is of course important that the onsite excavations do not endanger the adjacent properties. Excavations on the subject site should not extend below the zone of influence of any adjacent structure footings, without first installing temporary support or discussing the works with a geotechnical engineer.

Due to the sandy nature of the soils and the presence of groundwater, if excavations are carried out, temporary support of the excavations may be provided using secant piles.

The major consideration when selecting earth pressure coefficients for the design of retaining walls is the need to limit deformations that can take place outside the excavation. When considering the design of the supports, it will be necessary to allow for the loading from structures in adjoining properties, any ground surface slope, and any water table present. The surcharge load from the existing structures must be considered when designing the temporary and permanent retaining structures. Where the structures in adjoining properties are within the zone of influence of the excavation, it will be necessary to adopt K_0 conditions when designing the temporary support. Anchors or props can be used to provide the required support.

If anchors extend into adjoining property, it will be necessary to obtain the permission of the property owners. When props or anchors are used for support, a rectangular earth pressure distribution should be adopted on the active side of the support. K_0 should also be used to design the permanent support. It should be noted that some councils do not permit the use of permanent anchors.

When undertaking a finite element assessment (WALLAP/PLAXIS), the relevant soil and rock parameters applicable are provided in Table 5.1.

Table 5.1– Design Parameters

Material ¹	Unit 1 Topsoil	Unit 2 VL to L-MD Sands	Unit 3 D Sands	Unit 4 VSt to H Clays	Unit 5 Sandstone (Class V)	Unit 6 Sandstone (Class III)	
Depth to Top of Unit (mBEGl)	0.0	0.2 to 0.5	4.5 to 6.0	19.5 to 21.5	28.5 to 30.0	33.2 to 34.0	
RL of Top of Unit (mAHD)	8.0 to 8.4	7.5 to 8.0	2.2 to 3.9	-11.5 to -13.2	-20.3 to -21.7	-25.0 to -25.7	
Bulk Unit Weight γ (kN/m ³)	17	17	19	20	22	23	
Friction Angle ϕ' (Degrees)	24	24	32	28	28	40	
Cohesion, c' (kPa)	0	0	0	10	50	200	
Poisson's ratio, ν'	0.3	0.3	0.3	0.3	0.25	0.25	
Young's Modulus of Elasticity, E' (MPa)	-	6	60	60	100	500	
Earth Pressure Coefficients	At rest K_0 ³	0.6	0.6	0.47	0.50	0.50	0.35
	Active K_a ³	0.4	0.4	0.31	0.33	0.33	0.22
	Passive K_p ³	2.4	2.4	3.25	3.0	3.0	4.5
Allowable Bearing Pressure (kPa) ⁵	-	-	-	-	1000	3500	
Allowable Shaft Adhesion (kPa) ^{4,5}	In Compression	-	-	-	-	100	350
	In Uplift	-	-	-	-	40	175
Allowable Toe Resistance (kPa)	-	-	-	-	100	200	
Allowable Bond Stress (kPa)	-	-	-	-	80	350	

Notes:

- 1 More detailed descriptions of subsurface conditions are available on the borehole logs presented in **Appendix A**.
- 2 Approximate depths below existing ground level at the time of our investigation.
- 3 Earth pressures are provided on the assumption that the ground behind the retaining walls is horizontal.
- 4 Side adhesion values given assume there is intimate contact between the pile and foundation material and should achieve a clean socket roughness category R2 or better. Design engineer to check both 'piston pull-out' and 'cone lift out' mechanics in accordance with AS4678-2002 Earth Retaining Structures.
- 5 To adopt these parameters, we have assumed that:
 - Footings have a nominal socket of at least 0.3m, into the relevant founding material,
 - For piles, there is intimate contact between the pile and foundation material (a clean socket roughness category of R2 or better),
 - Potential soil and groundwater aggressivity will be considered in the design of piles and footings.

5.7. Foundation Design

Due to the potential for excessive settlements and low bearing strength, the very loose and loose to medium dense sands are not recommended for providing foundation support.

Piles may be used to support the structure. For piles founded in sand, the capacity of the pile will depend on the depth of founding. We will be happy to determine the required founding depth once the pile loads have been provided to us. Alternatively, piles founded in sandstone may be used, and these may be proportioned for the allowable bearing pressures given in Table 5.1.

The allowable bearing pressures given in Table 5.1 are based on the serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the minimum footing dimension (or pile diameter).

Grout Injected CFA piles are recommended for this site. Due to the collapsible nature of the sands and the presence of groundwater, conventional bored cast in-situ piles are not suitable for this site. For piles founded into sandstone bedrock, relatively large capacity piling rigs with rock augers and coring buckets will be required if drilling through the sandstone bedrock. Further advice should be sought from prospective piling contractors who should be provided with a copy of this report.

5.8. Groundwater Considerations

As detailed in section 4.2, the groundwater level is about 1.5 mBGL. Dewatering has the potential to cause some drawdown and ground settlement below adjoining sites; the extent of the drawdown depends upon the depth to which the cut-off system is installed and the pumping operations. Settlements would affect any adjoining buildings supported on shallow footing systems and if records of the footing systems of the adjoining buildings are available, these should be reviewed to assess the risk from dewatering. Because there is no basement excavation, STS does not anticipate that dewatering will be required.

If a pile rig working platform is proposed, we recommend it be placed as early as possible to reduce disturbance. STS can carry out a working platform assessment should this be required.

5.9. Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulfates and chlorides. To determine the degree of aggressiveness, the test values obtained are compared to Tables 6.4.2 (C) and 6.5.2 (C) in AS2159 – 2009 Piling – Design and Installation. For completeness, the test results from the 2021 investigation are included in here and are summarised in Table 5.2.

Table 5.2 – Soil Aggressiveness Summary

Location	Depth (m)	pH	Chloride (mg/kg)	Sulfate (mg/kg)	Electrical Conductivity (dS/m)	
					EC _{1.5}	EC _e
BH1	7.5 – 7.75	5.7	<10	10	0.012	0.2
BH2	6.0 – 6.45	6.2	<10	20	<0.001	<0.017
BH3	6.0 – 6.45	5.6	<10	20	<0.001	<0.017
BH4	7.5 – 7.8	6.9	20	40	0.007	0.1
BH5	6.0 – 6.45	5.9	<10	20	0.008	0.1

The soils are high permeability and below groundwater. Therefore, soil conditions A are considered appropriate (AS2159-2009).

A review of the durability aspects indicates that:

- pH : minimum value of 5.6
- SO₄ : maximum value of 40 mg/kg (ppm) < 5000 ppm
- Cl : maximum value of 20 mg/kg (ppm) < 5000 ppm
- EC_e : maximum value of 0.2 dS/m

In accordance with AS2159-2009 the exposure classification for the onsite soils is non-aggressive for both concrete and steel. In accordance with AS2870-2011 the soils are classified as A1.

Reference to DLWC (2002) “Site Investigations for Urban Salinity” indicates that EC_e values of <0.017 to 0.1 dS/m are consistent with the presence of non-saline soils.

6. ACID SULFATE ASSESSMENT

6.1. Introduction

ASS is the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed most acid sulfate sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers, and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, backswamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion,

these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the water table.

Any lowering in the water table that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development.

Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must consider the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics are not disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed in coastal areas, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

6.2. Presence of ASS

Reference to the Botany Bay (91 30S3) Edition Two, December 1997, ASS Risk Map indicates the property is within an area where there is a low probability of ASS occurring at a depth greater than 3 metres below the ground surface. The ASS risk map indicates that the soils at this site are aeolian in nature and were deposited as a sandplain. It should be noted that maps are a guide only.

The following geomorphic or site criteria are normally used to determine if ASS are likely to be present:

- sediments of recent geological age (Holocene)
- soil horizons less than 5 in AHD
- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

6.3. Assessment

A geomorphological assessment for PASS was undertaken by a review of available geomorphic mapping and aerial photography (Google Earth and SIX Maps (<https://maps.six.nsw.gov.au/>)) to identify, interpret, and compare features against site geomorphic characteristics (sediment, landscape and vegetation) noted in Tables 2.1 and 4.1

of NASSG 2018a that indicate typical locations of PASS. The typical PASS features and results of review are presented in Table 6.1.

Table 6.1 – PASS Features and results of review

Geomorphological Indicator Type	Indicator of ASS	Site Presence of Feature
Sediment characteristics	Sediments of recent geological age (Holocene)	Observed.
	Marine or estuarine sediments	Not observed
	Iron sulfide minerals, former marine or shales and sediments, coal deposits, and mineral sand deposits	Not observed
	Deep estuarine sediments >10m below ground surface, Holocene or Pleistocene age (only if deep excavation or drainage is proposed)	Deep excavation is not proposed
	Areas known to contain peat or a build-up of organic material.	No peat observed
Landscape characteristics	Land with elevation less than 5 m AHD	Minimum ground RL onsite is approximately 8 m AHD
	Areas where the highest known water table level is within 3 m of the surface.	Not observed
	Waterlogged or scalded area	Not observed
	Tidal lakes	Not observed
	Coastal wetlands or back swamp areas	Not observed
	Interdune swales or coastal sand dunes (if deep excavation or drainage is proposed)	Not observed
	Any areas (including inland areas) where a combination of all the following factors exist: organic matter, iron minerals, waterlogged conditions or high water table, and sulfidic minerals.	Not observed

Geomorphological Indicator Type	Indicator of ASS	Site Presence of Feature
Vegetation characteristic	Areas where the dominant vegetation is mangroves, reeds, rushes and other vegetation associated with areas of shallow water tables such as flooded gums (<i>Eucalyptus rudis</i>) (<i>Eucalyptus robusta</i>), paperbarks (<i>Melaleucaspp.</i>) and casuarinas (<i>Casuarina spp.</i>).	Not observed

To assess the significance of the PASS, the following field methodology was conducted.

- Laboratory testing was carried out on samples taken from BH4 at depths of 0.5 m, 1.5m, 3.0m, 4.5m, 6.0m, and 7.5m, below existing ground level.
- Six samples were sent to a NATA accredited laboratory for Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) testing.

From the provided scheme and based on measurements from MetroMaps, STS estimates that >1000m³ of material will be removed for the proposed development.

The laboratory results are summarised in Table 5.3, with the full test results available in Appendix B. The test results were compared to action criteria for 1-1000 tonnes of potential ASS disturbed material, as referenced in NSW Acid Sulfate Soil Management Advisory Committee, Acid Sulfate Soil Manual (ASSMAC,1998) summarised in Table 6.2.

The action criteria trigger needed to prepare an ASSMP and are based on the percentage of oxidisable sulphur (or equivalent TPA and TSA) for broad categories of soil types. Works in soils that exceed these action criteria must prepare a management plan and obtain development consent.

Table 6.2 – ASS Action Criteria

Type of material		Action Criteria if 1-1000 tonnes ASS disturbed		Action Criteria if more than 1000 tonnes ASS disturbed	
Texture Range (McDonald et al 1990)	Approx. clay content (%<0.02mm)	Sulphur Trail %S oxidisable (oven dry basis) eg S_{TOS} or S_{POS}	Acid Trail Mol H^+ /tonne (oven dry basis) eg TPA or TSA_S	Sulphur Trail %S oxidisable (oven dry basis) eg S_{TOS} or S_{POS}	Acid Trail Mol H^+ /tonne (oven dry basis) eg TPA or TSA_S
Coarse Texture (CT) Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture (MT) Sandy loams to light clays	5-50	0.06	36	0.03	18
Fine Texture (FT) Medium to heavy clays and silty clays	≥50	0.1	62	0.03	18

Since sands were encountered the coarse texture (CT) grade criteria is the most appropriate and has been adopted for this assessment.

The results of the soil sample analyses are compared to the above criteria in Table 6.3, and the analytical laboratory reports for the testing performed are provided in Appendix B.

Table 6.3 – SPOCAS Test Results Summary

Analysis	Unit	LOR	ASS1 BH4 @ 0.5m	ASS2 BH4 @ 1.5m	ASS3 BH4 @ 3.0m	ASS4 BH4 @ 4.5m	ASS5 BH4 @ 6.0m	ASS6 BH4 @ 7.5m	Action Criteria ¹ >1000 tonnes disturbed
pH before Oxidation	NA	0.1	6.6	6.3	5.5	5.7	5.8	6.4	-
pH after Oxidation	NA	0.1	7.4	4.6	3.9	4.0	4.2	5.6	<3 (high risk)
S (POS)	%	0.02	<0.020	0.044	0.021	<0.020	<0.020	<0.020	0.03
TPA	Mole/ tonne	2	<2	14	55	32	12	<2	18
TSA	Mole/ tonne	2	<2	14	44	27	12	<2	18

1 = ASSMAC (1998)

 Action Criteria Exceeded

The S(POS) concentration for ASS2 exceeded the action criteria of 0.03, and both the TPA and TSA concentrations for ASS3 and ASS4 exceeded the action criteria of 18. Based on the criteria and methodology adopted by STS for this ASS assessment, the results indicated the potential presence of ASS and an ASSMP was therefore recommended.

However, following STS’s ASS assessment, a further additional ASS assessment involving additional sampling and data gaps and testing parameters was carried out by Alliance Geotechnical Pty Ltd. The details of this assessment by Alliance are detailed in the DSI report referenced in Section 1. As outlined in Page 82 of the DSI report, the methodology adopted by Alliance included testing for the presence of Jarosite and Chromium Reducible Sulfur. In the latest referenced DSI report, Alliance assessed the soils to be naturally occurring acidic soils, and not acid sulfate soils and concludes that management plan is not required.

6. FINAL COMMENTS

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

- Dilapidation surveys;
- Design of working platforms for piling rigs (if required), by an experienced and qualified geotechnical engineer;
- Site Preparation works and Earthwork Supervision:
- Verification of working platform using Plate Load Tests:
- Classification of all excavated material (piles) transported off site;
- Geotechnical inspections of all new footings or slabs by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata.

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

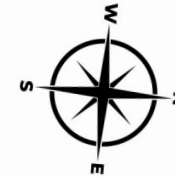
During construction, STS should be contacted to determine if any changes should be made to our recommendations for further advice.



*Lucky Ly
BEng (Civil) Hons
Geotechnical Engineer
STS Geotechnics Pty Limited*



*Mrigesh Tamang
MIE Aust, CPEng, NER, APEC Engineer, IntPE(Aust)
Senior Geotechnical Engineer
STS Geotechnics Pty Limited*



	Latitude (WGA84)	Longitude (WGA84)	Approximate Surface RL (m)
BH1	33.925271 347 S ^o	151.194771 732 E ^o	8.022
BH2	33.925104 803 S ^o	151.195018 428 E ^o	8.200
BH3	33.924806 412 S ^o	151.194890 642 E ^o	8.205
BH4	33.925353 044 S ^o	151.195235 940 E ^o	8.385
BH5	33.924973 511 S ^o	151.195465 3313 E ^o	8.283

Base map taken from MetroMaps. Groundwater monitoring wells installed in BH1 and BH5



14/1 Cowpasture Place, Wetherill Park, NSW 2164, Australia
 (PO Box 6989, Wetherill Park, NSW 2164, Australia)
 T +61 2 9756 2166 | F +61 2 9756 1137
www.stsgeo.com.au | enquiries@stsgeo.com.au
 ABN 45 636 179 729 | ACN 636 179 729

Borehole Locations

Client:	Homes NSW	Project No.	32630/8546D-G	Date:	10/04/2024
Site Address:	776, 792—794 Botany Road, 33—37 Henry Kendall Crescent, Mascot	Drawing No.	24/0856	Scale:	Not to Scale
Work:	Geotechnical Investigation	Revision No.	0		

INTRODUCTION

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report. When copies of reports are made, they should be reproduced in full.

GEOTECHNICAL REPORTS

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by STS Geotechnics Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, STS Geotechnics Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

UNFORSEEN CONDITIONS

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, STS Geotechnics Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

SUBSURFACE CONDITIONS

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

SUPPLY OF GEOTECHNICAL INFORMATION OR TENDERING PURPOSES

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A – BOREHOLE LOGS, CORE PHOTOGRAPHS,
POINT LOAD TESTING RESULTS AND EXPLANATION SHEETS


Client Homes NSW	Date 03 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.02 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
03/04/2024 02:53 PM 		0.0		TOPSOIL: Silty SAND: dark brown, fine to medium grained, with rootlets	-	-	-
	BH1_0.50-0.95 SPT 0.50-0.95 3,2,3 N=5	0.5		Silty SAND: grey, dark grey, fine to medium grained	SM	VL - L	M
	BH1_1.50-1.95 SPT 1.50-1.95 1,1,2 N=3	1.5		Becoming brown			
	BH1_3.00-3.45 SPT 3.00-3.45 2,2,1 N=3	3.0		Organic Sandy SILT: black, fine to medium grained, sulfurous odour	OM		
	BH1_4.50-4.95 SPT 4.50-4.95 10,17,23 N=40	4.5		Silty SAND: brown, orange, fine to medium grained	SM	D	W
	BH1_7.50-7.75 SPT 7.50-7.75 13,17/100 mm HB N=R	7.5		Becoming pale grey			
	BH1_9.00-9.45 SPT 9.00-9.45 5,20,8 HB N=28	9.0		Becoming brown			

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)


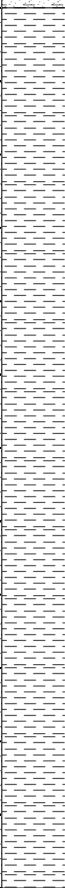
Client Homes NSW	Date 03 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.02 m (AHD) Drill Bit WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5		Silty SAND: brown, grey, fine to medium grained	SM	D	W
				Sandy CLAY: brown, low to medium plasticity	CL-CI	VSt - H	W > PL

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 03 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.02 m (AHD) Drill Bit WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION					
		20.5		Sandy CLAY: brown, low to medium plasticity	CL-CI	VSt - H	W > PL					
		21.0										
		21.5										
		22.0										
		22.5										
		23.0										
		23.5										
		24.0							Silty CLAY: high plasticity, grey	CH	VSt - H	W > PL
		24.5										
		25.0										
		25.5										
		26.0										
		26.5										
		27.0										
		27.5										
		28.0										
		28.5										
		29.0										
		29.5		Terminated at 29.50m. Refusal on Extremely Weathered Sandstone								

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 09 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 305	Inclination 90° Hole Ø (mm) 100


GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
				TOPSOIL: Silty SAND: dark brown, fine to medium grained, with rootlets	-	-	-
		0.5		Silty SAND: brown, fine to medium grained		L	M
		1.0					
		1.5					
		2.0					
		2.5					
		3.0					
		3.5					
		4.0			SM	L - MD	
		4.5					
		5.0					
		5.5					
		6.0					
		6.5					
		7.0					
		7.5					
		8.0				D	
		8.5					
		9.0					
		9.5					

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 09 April 2024	
Job No. 32630/8546D-G	Logged By MT/EK	Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856	

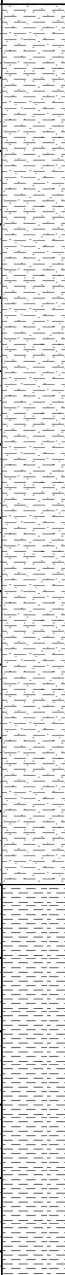
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD)	Drill Bit WB
Plant Comacchio Geo 305	Inclination 90°	Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5		Silty SAND: brown, fine to medium grained	SM	D	W

Notes: See explanation sheets for meaning of all descriptive terms and symbols

Client Homes NSW	Date 09 April 2024	
Job No. 32630/8546D-G	Logged By MT/EK	Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856	

Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD)	Drill Bit WB
Plant Comacchio Geo 305	Inclination 90°	Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5		Sandy CLAY: yellow brown, medium plasticity	CI	VSt - H	M > PL
				Silty CLAY: grey brown, high plasticity, very high resistance during drilling	CH	VSt - H	M>PL
				<i>Continued as cored log on next page</i>			

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 09 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD) Drill Bit WB
Plant Comacchio Geo 305	Inclination 90° Hole Ø (mm) 100

METHOD	Flush Return	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (m(AHD))	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)		DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING						
									▼ - Axial	▽ - Diametral		30	100	300	1000	3000		
				20			<i>Log continued from previous page.</i>											
				21														
				22														
				23														
				24														
				25														
				26														
				27														
				28														
				29			Started coring at 28.7m EXTREMELY WEATHERED SANDSTONE: recovered as silty clay, grey, high plasticity, with fine to medium grained sand	▼										
	100% Water			30				▼										

Client Homes NSW	Date 09 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD) Drill Bit WB
Plant Comacchio Geo 305	Inclination 90° Hole Ø (mm) 100

METHOD	Flush Return	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (m(AHD))	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)						DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING				
									VL ₀₋₁	L ₀₋₃	M ₁	H ₃	VH ₁₀	EH		30	100	300	1000	3000
NMLC	100% Water	100	0	30.00		21.80	SANDSTONE: pale grey, brown, fine to medium grained	XW	▼											
		100	66	32.20		24.00	SANDSTONE: brown, fine to medium grained, medium to thickly bedded	DW - XW	▼											
				33.05				FR - DW	▼											
				34.48			Terminated at 34.50m.		▼											

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

CORE PHOTOGRAPH OF BOREHOLE: BH2

Job No.	32630/8546D-G	East	33.925104803 S°	Contractor	Terratest
Location	776, 792 – 794 Botany Road, 33 – 37 Henry Kendall Crescent, Mascot	North	151.195018428 E°	Drill Rig	Commachio Geo 305
Client	Homes NSW	Surface RL	8.200 m	Logger	MT/EK
				Date	09/04/2024



Client Homes NSW	Date 10 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 305	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
				TOPSOIL: Silty SAND: dark brown, fine to medium grained, with rootlets	-	-	-
		0.5		Silty SAND: brown, fine to medium grained	SM	L	M
		1.0					
		1.5					
		2.0		Silty SAND: yellow brown, fine to medium grained, trace of clay			
		2.5					
		3.0					
		3.5				L - MD	
		4.0					
		4.5					
		5.0					
		5.5			SM		W
		6.0					
		6.5					
		7.0					
		7.5					
		8.0				D	
		8.5					
		9.0					
		9.5					

BH3_6.00-6.45
SPT 6.00-6.45
11,17,25 N=42

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water	Sheet 1 of 5
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)	

Client Homes NSW	Date 10 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856

Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD)	Drill Bit WB
Plant Comacchio Geo 305	Inclination 90°	Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
	BH3_12.00-12.45 SPT 12.00-12.45 10,19,29 N=48	10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5		Silty SAND: yellow brown, fine to medium grained, trace of clay	SM	D	W

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client	Homes NSW	Date	10 April 2024
Job No.	32630/8546D-G	Logged By	MT/EK
Address	776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Review By	MT
Drilling Contractor	Terratest	Surface RL	≈8.20 m (AHD)
Plant	Comacchio Geo 305	Drill Bit	WB
		Inclination	90°
		Hole Ø (mm)	100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		20.5		Silty SAND: yellow brown, fine to medium grained, trace of clay		D	W
		21.0					
		21.5		Sandy CLAY: medium plasticity, grey brown, very high resistance during drilling	CI		
		22.0					
		22.5					
		23.0		Silty CLAY: high plasticity, dark grey			
		23.5					
		24.0					
		24.5				VSt - H	M > PL
		25.0					
		25.5			CH		
		26.0					
		26.5					
		27.0					
		27.5					
		28.0		<i>Continued as cored log on next page.</i>			
		28.5					
		29.0					
		29.5					

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 10 April 2024
Job No. 32630/8546D-G	Logged By MT/EK Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Terratest	Surface RL ≈8.20 m (AHD) Drill Bit WB
Plant Comacchio Geo 305	Inclination 90° Hole Ø (mm) 100

METHOD	Flush Return	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (m(AHD))	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)						DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING				
									VL ₀₋₁	L ₀₋₃	M ₁	H ₃	VH ₁₀	EH		30	100	300	1000	3000
NMLC	100% Water	100	0	30		22.30	EXTREMELY WEATHERED SANDSTONE: grey, fine to medium grained	XW												
				31																
				32																
				33																
				33.50		25.30	SANDSTONE: pale grey, brown, fine to medium grained, some iron staining, very thinly bedded to thickly bedded	FR-DW							33.60: BP PR RO					
				34											33.70: BP PR RO					
				35				FR							33.88: BP 20° PR RO					
				35											34.94: BP 20° CU RO					
				36		27.80	Terminated at 36.00m.													
				37																
				38																
				39																
				40																

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

CORE PHOTOGRAPH OF BOREHOLE: BH3

Job No.	32630/8546D-G	Latitude	33.924806412 S°	Contractor	Terratest
Location	776, 792 – 794 Botany Road, 33 – 37 Henry Kendall Crescent, Mascot	Longitude	151.194890642 E°	Drill Rig	Commachio Geo 305
Client	Homes NSW	Surface RL	8.205 m	Logger	MT
				Date	10/04/2024



Client Homes NSW	Date 05 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.38 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		0.5		TOPSOIL: Silty SAND: dark brown, fine to medium grained, with rootlets	-	-	
	D (0.40-0.50)	1.0		Silty SAND: dark brown, fine to medium grained			M
	BH2_1.50-1.95 SPT 1.50-1.95 0,0,1 N=1	1.5		Becoming grey			
		2.0		Becoming brown		VL	
		2.5			SM		
	BH2_3.00-3.45 SPT 3.00-3.45 3,3,4 N=7	3.0		Silty SAND: reddish brown, fine to medium grained, sulfurous odour			
		3.5				L	
		4.0			SM		
	BH2_4.50-4.95 SPT 4.50-4.95 15,16,19 N=35	4.5					
		5.0		Silty SAND: brown, fine to medium grained			
		5.5					
	BH2_6.00-6.26 SPT 6.00-6.26 17,26/110 mm HB N=R	6.0					
		6.5					
		7.0					
		7.5			SM		
	BH2_7.50-7.80 SPT 7.50-7.80 13,27/150 mm HB N=R	7.5					
		8.0					
		8.5					
		9.0					
		9.5		Clayey SAND: brown, fine to medium grained	SC	D	

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client	Homes NSW	Date	05 April 2024
Job No.	32630/8546D-G	Logged By	LL
Address	776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Review By	MT
Drilling Contractor	Geosense Drilling Engineers	Surface RL	≈8.38 m (AHD)
Plant	Comacchio Geo 205	Drill Bit	WB
		Inclination	90°
		Hole Ø (mm)	100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION	
		10.5						
		11.0						
		11.5						
		12.0			Silty SAND: brown, fine to medium grained			
		12.5						
		13.0						
		13.5						
		14.0						
		14.5						
		15.0				SM	D	W
		15.5						
		16.0						
		16.5						
		17.0						
		17.5						
		18.0						
		18.5						
		19.0						
		19.5						

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water	Sheet 2 of 3
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)	

Client Homes NSW	Date 05 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.38 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		20.5					
		21.0					
		21.5		Sandy CLAY: medium plasticity, brown, high resistance to drilling	CI	VSt - H	
		22.0					
		22.5					
		23.0		Silty CLAY: medium to high plasticity, grey			
		23.5					
		24.0					
		24.5					
		25.0					W > PL
		25.5					
		26.0					
		26.5			CI-CH	VSt - H	
		27.0					
		27.5					
		28.0					
		28.5					
		29.0					
		29.5					
Terminated at 30.00m. Refusal on Extremely Weathered Sandstone.							

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client Homes NSW	Date 08 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.28 m (AHD) Drill Bit AD/T + WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		0.0		TOPSOIL: Silty SAND: dark brown, fine to medium grained	-	-	-
		0.5		Silty SAND: brown, fine to medium grained			M
		1.0					
		1.5					
		2.0					
		2.5					
		3.0					
		3.5				L	
		4.0					
		4.5					
		5.0			SM		
		5.5					
		6.0					W
		6.5					
		7.0					
		7.5					
		8.0				D	
		8.5					
		9.0					
		9.5					

BH5_6.00-6.45
SPT 6.00-6.45
8,16,18 N=34

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water	Sheet 1 of 5
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)	

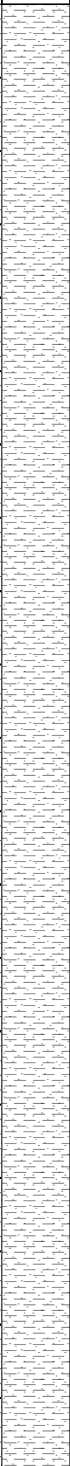
Client Homes NSW	Date 08 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.28 m (AHD) Drill Bit WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		10.5		Silty SAND: brown, fine to medium grained	SM	D	W
		11.0		Becoming black			
		11.5					
		12.0					
		12.5					
		13.0		Becoming brown			
		13.5					
		14.0					
		14.5					
		15.0					
		15.5					
		16.0	Becoming black				
		16.5					
		17.0					
		17.5					
		18.0		Clayey SAND: brown, fine to medium grained	SC		
		18.5					
		19.0					
		19.5					

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

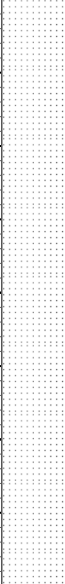
Client Homes NSW	Date 08 April 2024
Job No. 32630/8546D-G	Logged By LL Review By MT
Address 776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Location # 24/0856
Drilling Contractor Geosense Drilling Engineers	Surface RL ≈8.28 m (AHD) Drill Bit WB
Plant Comacchio Geo 205	Inclination 90° Hole Ø (mm) 100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION
		20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5		Sandy CLAY: medium plasticity, brown	CI	Vst - H	M > PL

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

Client	Homes NSW	Date	08 April 2024
Job No.	32630/8546D-G	Logged By	LL
Address	776, 792 - 794 Botany Road, 33 - 37 Kendall Crescent, Mascot	Review By	MT
Drilling Contractor	Geosense Drilling Engineers	Surface RL	≈8.28 m (AHD)
Plant	Comacchio Geo 205	Drill Bit	WB
		Inclination	90°
		Hole Ø (mm)	100

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	CLASSIFICATION SYMBOL	CONSISTENCY / REL. DENSITY	MOISTURE CONDITION				
		30.5		EXTREMELY WEATHERED SANDSTONE: grey brown, fine to medium grained, recovered as clayey sand	-		M > PL				
		31.0									
		31.5									
		32.0									
		32.5									
		33.0									
		33.5									
		34.0									
		34.5						<i>Continued as cored log on next page.</i>			
		35.0									
		35.5									
		36.0									
		36.5									
		37.0									
		37.5									
		38.0									
		38.5									
		39.0									
		39.5									

Notes: See explanation sheets for meaning of all descriptive terms and symbols

D - disturbed sample	S - jar sample	WT - level of water table or free water
U - undisturbed tube sample	B - bulk sample	N - Standard Penetration Test (SPT)

CORE PHOTOGRAPH OF BOREHOLE: BH5

Job No.	32630/8546D-G	East	33.924973511 S°	Contractor	Geosense Drilling Engineers		
Location	776, 792 – 794 Botany Road, 33 – 37 Henry Kendall Crescent, Mascot	North	151.1954653313 E°	Drill Rig	Commachio Geo 205		
Client	Homes NSW	Surface RL	8.283 m	Logger	LL	Date	07-08/04/2024



Point Load Strength Index Report

Project: 776, 792-794 BOTANY ROAD, 33-37 HENRY KENDALL CRESCENT, MASCOT

Project No.: 32630/8546D-G

Client: HOMES NSW

Report No.: 24/0896

Address: 4 Parramatta Square, Darcy Street, Parramatta

Report Date: 15/04/2024

Test Method: AS4133.4.1

Page: 1 of 2

Sampling Procedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Borehole / Sample No.	Depth (m)	Date Sampled	Date Tested	Test Type	Is (MPa)	Is ₍₅₀₎ (MPa)	Rock Type	Failure Type	Moisture
BH2	28.75	09/04/2024	11/04/2024	D	0.068	0.069	YS	3	M
BH2	28.75	09/04/2024	11/04/2024	A	0.037	0.037	YS	3	M
BH2	29.75	09/04/2024	11/04/2024	D	0.076	0.077	YS	3	M
BH2	29.75	09/04/2024	11/04/2024	A	0.043	0.045	YS	3	M
BH2	30.20	09/04/2024	11/04/2024	D	0.093	0.095	YS	3	M
BH2	30.20	09/04/2024	11/04/2024	A	0.088	0.09	YS	3	M
BH2	31.60	09/04/2024	11/04/2024	D	0.045	0.046	YS	3	M
BH2	31.60	09/04/2024	11/04/2024	A	0.04	0.04	YS	3	M
BH2	32.20	09/04/2024	11/04/2024	D	0.098	0.099	SS	3	M
BH2	32.20	09/04/2024	11/04/2024	A	0.079	0.08	SS	3	M
BH2	32.74	09/04/2024	11/04/2024	D	0.053	0.054	SS	3	W
BH2	32.74	09/04/2024	11/04/2024	A	0.054	0.054	SS	3	W
BH2	33.20	09/04/2024	11/04/2024	D	0.49	0.5	SS	3	M
BH2	33.20	09/04/2024	11/04/2024	A	0.65	0.66	SS	3	M
BH2	34.42	09/04/2024	11/04/2024	D	0.63	0.64	SS	3	W
BH2	34.42	09/04/2024	11/04/2024	A	0.71	0.73	SS	3	M
BH3	27.70	10/04/2024	12/04/2024	D	0.034	0.035	ST	3	M
BH3	27.70	10/04/2024	12/04/2024	A	0.028	0.03	ST	3	M
BH3	28.49	10/04/2024	12/04/2024	D	0.079	0.08	ST	3	D
BH3	28.49	10/04/2024	12/04/2024	A	0.055	0.058	ST	3	D
BH3	29.18	10/04/2024	12/04/2024	D	0.067	0.068	ST	3	D
BH3	29.18	10/04/2024	12/04/2024	A	0.093	0.097	ST	3	D
BH3	30.73	10/04/2024	12/04/2024	D	0.096	0.098	ST	3	D
BH3	30.73	10/04/2024	12/04/2024	A	0.069	0.07	ST	3	D
BH3	31.44	10/04/2024	12/04/2024	D	0.076	0.078	ST	3	D
BH3	31.44	10/04/2024	12/04/2024	A	0.074	0.076	ST	3	D
BH3	32.44	10/04/2024	12/04/2024	D	0.048	0.049	ST	3	D
BH3	32.44	10/04/2024	12/04/2024	A	0.046	0.047	ST	3	D
BH3	33.29	10/04/2024	12/04/2024	D	0.051	0.052	ST	3	D

Failure Type

- 1 = Fracture through bedding or weak plane
- 2 = Fracture along bedding
- 3 = Fracture through rock mass
- 4 = Fracture influenced by natural defect or drilling
- 5 = Partial fracture or chip (invalid result)

Test Type

- A = Axial
- D = Diametrial
- I = Irregular
- C = Cube

Moisture Condition

- W = Wet
- M = Moist
- D = Dry

Rock Type

- SS = Sandstone
- ST = Siltstone
- SH = Shale
- YS = Claystone
- IG = Igneous

Remarks:

Approved Signatory..... 

Mrigesh Tamang

Technician: DC

DRILLING/EXCAVATION METHOD





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

PENETRATION RESISTANCE

L	Low Resistance	Rapid penetration/ excavation possible with little effort from equipment used.
M	Medium Resistance	Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.
H	High Resistance	Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.
R	Refusal/Practical Refusal	No further progress possible without risk of damage or unacceptable wear to equipment used.

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



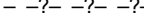
WATER

	 Standing Water Level	 Partial water loss
	 Water Seepage	 Complete Water Loss
GWNO	GROUNDWATER NOT OBSERVED - Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.	
GWNE	GROUNDWATER NOT ENCOUNTERED - Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.	

SAMPLING AND TESTING

SPT	Standard Penetration Testing to AS1289.6.3.3 2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following a 150mm seating drive
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported, N is not reported
RW	Penetration occurred under the rod weight only, N<1
HW	Penetration occurred under the hammer and rod weight only, N<1
HB	Hammer double bouncing on anvil, N is not reported
Sampling	
S1	Jar sample – number indicates sample number
D	Disturbed Sample
B	Bulk disturbed Sample
U50	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
PP	Pocket Penetrometer test expressed as instrument reading in kPa
DCP	Dynamic Cone Penetrometer (AS1289.6.3.1 1997)
PSP	Perth Sand Penetrometer (AS1289.6.3.2 1997)

GEOLOGICAL BOUNDARIES

	= Observed Boundary (Position known)		= Observed Boundary (Position approximate)		= Boundary (Interpreted or inferred)
---	---	---	---	---	---

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

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

RQD = Rock Quality Designation (%)

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

CLASSIFICATION AND INFERRED STRATIGRAPHY

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

ROCK MATERIAL STRENGTH CLASSIFICATION

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

Rock Strength Test Results ▼ Point Load Strength Index, $I_{s(50)}$, Axial test (MPa)

● Point Load Strength Index, $I_{s(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($I_{s(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. However UCS is typically 20 x $I_{s(50)}$.

ROCK MATERIAL WEATHERING CLASSIFICATION

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

CLASSIFICATION AND INFERRED STRATIGRAPHY

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

DETAILED ROCK DEFECT SPACING

Defect Spacing			Bedding Thickness (Stratification)	
Spacing/width (mm)	Descriptor	Symbol	Term	Spacing (mm)
<20	Extremely Close	EC	Thinly laminated	<6
			Laminated	6 – 20
20-60	Very Close	VC	Very thinly bedded	20 – 60
60-200	Close	C	Thinly bedded	60 – 200
200-600	Medium	M	Medium bedded	200 – 600
600-2000	Wide	W	Thickly bedded	600 – 2,000
2000-6000	Very Wide	VW	Very thickly bedded	> 2,000

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Contact	CO	The surface between two types or ages of rock.
Sheared Surface	SSU	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Extremely Weathered Seam/ Zone	XWS/XWZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	PR	Consistent orientation	Polished	POL	Shiny smooth surface
Curved	CU	Gradual change in orientation	Slickensided	SL	Grooved or striated surface, usually polished
Undulating	UN	Wavy surface	Smooth	SM	Smooth to touch. Few or no surface irregularities
Stepped	ST	One or more well defined steps	Rough	RO	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	IR	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

DEFECT COATING			DEFECT APERTURE		
Coating	Abbr.	Description	Aperture	Abbr.	Description
Clean	CN	No visible coating or infilling	Closed	CL	Closed.
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)	Open	OP	Without any infill material.
Veneer	VNR	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy	Infilled	-	Soil or rock i.e. clay, silt, talc, pyrite, quartz, etc.

APPENDIX B – LABORATORY TEST RESULTS



CERTIFICATE OF ANALYSIS

Work Order	: ES2413010	Page	: 1 of 2
Client	: STS Geotechnics	Laboratory	: Environmental Division Sydney
Contact	: ENQUIRES STS	Contact	: Customer Services ES
Address	: Unit 14/1 Cowpasture Place Wetherill Park 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 32630/8546D-R	Date Samples Received	: 22-Apr-2024 13:55
Order number	: 2024-154	Date Analysis Commenced	: 22-Apr-2024
C-O-C number	: ----	Issue Date	: 23-Apr-2024 16:35
Sampler	: IS		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 5		
No. of samples analysed	: 5		



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 ^ = This result is computed from individual analyte detections at or above the level of reporting
 ø = ALS is not NATA accredited for these tests.
 ~ = Indicates an estimated value.

- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

				Sample ID	32630/S1	32630/S2	32630/S3	32630/S4	32630/S5
				Sampling date / time	10-Apr-2024 00:00	10-Apr-2024 00:00	10-Apr-2024 00:00	10-Apr-2024 00:00	10-Apr-2024 00:00
Compound	CAS Number	LOR	Unit		ES2413010-001	ES2413010-002	ES2413010-003	ES2413010-004	ES2413010-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.7	6.2	5.6	6.9	5.9
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		12	<1	<1	7	8
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		15.2	15.4	15.4	19.7	17.0
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		10	20	20	40	20
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		<10	<10	<10	20	<10



CERTIFICATE OF ANALYSIS

Work Order : **EB2411710**
Client : **STS Geotechnics**
Contact : ENQUIRES STS
Address : Unit 14/1 Cowpasture Place
Wetherill Park 2164
Telephone : ----
Project : 32630
Order number : 2024-121
C-O-C number : ----
Sampler : LL
Site : ----
Quote number : EN/222
No. of samples received : 6
No. of samples analysed : 6

Page : 1 of 6
Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 09-Apr-2024 11:00
Date Analysis Commenced : 16-Apr-2024
Issue Date : 16-Apr-2024 17:00



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA029 (SPOCAS): Analysis is performed as per the Acid Sulfate Soils Laboratory Methods Guidelines (2004) and the updated National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT (2018)
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA029 (SPOCAS): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m³ in-situ soil, multiply reported results x wet bulk density of soil in t/m³.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	32630/ASS1	32630/ASS2	32630/ASS3	32630/ASS4	32630/ASS5
Sampling date / time				04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00
Compound	CAS Number	LOR	Unit	EB2411710-001	EB2411710-002	EB2411710-003	EB2411710-004	EB2411710-005	
				Result	Result	Result	Result	Result	
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit	6.6	6.3	5.5	5.7	5.8	
pH OX (23B)	----	0.1	pH Unit	7.4	4.6	3.9	4.0	4.2	
EA029-B: Acidity Trail									
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	10	5	<2	
Titrateable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	14	55	32	12	
Titrateable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	14	44	27	12	
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020	
sulfidic - Titrateable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	0.022	0.088	0.051	0.020	
sulfidic - Titrateable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	0.022	0.071	0.043	0.020	
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020	
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	0.044	0.021	<0.020	<0.020	
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	0.044	0.021	<0.020	<0.020	
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	28	13	<10	<10	
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	0.105	0.057	<0.020	<0.020	<0.020	
Peroxide Calcium (23Wh)	----	0.020	% Ca	0.125	0.058	<0.020	0.037	<0.020	
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	<0.020	0.037	<0.020	
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	18	<10	
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	<0.020	0.030	<0.020	
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	<0.020	<0.020	<0.020	<0.020	<0.020	
Peroxide Magnesium (23Tm)	----	0.020	% Mg	<0.020	<0.020	<0.020	<0.020	<0.020	
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	<0.020	<0.020	<0.020	
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10	
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	32630/ASS1	32630/ASS2	32630/ASS3	32630/ASS4	32630/ASS5
Sampling date / time				04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00	04-Apr-2024 00:00
Compound	CAS Number	LOR	Unit	EB2411710-001	EB2411710-002	EB2411710-003	EB2411710-004	EB2411710-005	
				Result	Result	Result	Result	Result	
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	0.552	----	----	----	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	110	----	----	----	----	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	0.177	----	----	----	----	----
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	0.04	0.04	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	28	23	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	2	2	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	0.04	0.04	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	28	23	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	2	2	<1	<1	<1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Sample ID			32630/ASS6	----	----	----	----
		Sampling date / time			04-Apr-2024 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2411710-006	-----	-----	-----	-----	-----
				Result	---	---	---	---	---
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit	6.4	----	----	----	----	----
pH OX (23B)	----	0.1	pH Unit	5.6	----	----	----	----	----
EA029-B: Acidity Trail									
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----	----
Titrateable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----	----
Titrateable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----	----
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	----	----	----	----	----
sulfidic - Titrateable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	----	----	----	----	----
sulfidic - Titrateable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	----	----	----	----	----
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	----	----	----	----	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	----	----	----	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	----	----	----	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----	----
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	0.022	----	----	----	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	0.034	----	----	----	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	----	----	----	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	----	----	----	----	----
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	<0.020	----	----	----	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	<0.020	----	----	----	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	----	----	----	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	----	----	----	----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID				
				32630/ASS6	----	----	----	----
				Sampling date / time	04-Apr-2024 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2411710-006	-----	-----	-----	-----
				Result	----	----	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----



Geotechnical Investigation Report

Project
**792-794 Botany Rd and 33-37 Henry Kendal Crescent
Mascot NSW**

Prepared for
**New South Wales Land and Housing Corporation
(ABN 24 960 729 253)**

Date
15 October 2024

Report No
17716.3-GR-1-1-RevA




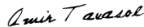
alliance
geotechnical & environmental solutions

Alliance Geotechnical Pty Ltd

Address: 8-10 Welder Road
Seven Hills, NSW
Phone: 1800 288 188
Office Email: info@allgeo.com.au
Web: www.allgeo.com.au

DOCUMENT CONTROL

Revision	Date	Description	Author	Reviewer
-	7/08/2024	First issue	SH	AT
A	15/10/2024	Geotechnical Investigation Report Update	SH/RM	AT

	Author	Reviewer
Signature		
Name	Sean Hannon	Amir Tavasol
Title	Experienced Geotechnical Engineer BSc MSc CGeol FGS	Associate Geotechnical Engineer BEng MEng CPEng MIEAust NER APEC Engineer IntPE (Aus)

Contents

1	INTRODUCTION	1
1.1	Site Description.....	1
2	PROPOSED DEVELOPMENT	2
3	REGIONAL GEOLOGY	2
4	FIELDWORK	3
4.1	Methods	3
4.2	Investigation Details.....	3
4.3	Encountered Subsurface Conditions	4
4.4	Groundwater	5
5	COMMENTS & RECOMMENDATIONS	5
5.1	Recommended Preliminary Material Strength Parameters	5
5.2	Excavation Conditions	6
5.3	Foundation System and Design Parameters.....	6
5.4	Site Preparation and Earthworks	7
6	LIMITATIONS	8
7	REFERENCES	8

Appendices

APPENDIX A – Site Photograph

APPENDIX B – Geotechnical Investigation Plan (Drawing 17716.3-GR-1-1-A)

APPENDIX C – Explanatory Notes, Interpreted CPT Logs

1 INTRODUCTION

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) on behalf of New South Wales Land and Housing Corporation operating as Homes NSW (the Client) for a State Significant Development Application (SSD-72393459) for the proposed development at 792-794 Botany Rd and 33-37 Henry Kendal Crescent, Mascot NSW.

The following documents were provided by the client to assist with the geotechnical investigation:

- Preliminary Architectural Plans by SJB Architects (Job No.6956, Drawing no. DA-1001 to -1009, DA-1401 to -1404, DA-1501 to -1507, DA-4111 to -4116, DA-4121 to -4127, DA-4131 to -4136, DA-4141 to -4143, DA-6110, and DA-6122), dated 23/09/2024.
- Architectural Drawing Plans by SJB Architecture (NSW) Pty Ltd, dated 10/10/2024.
- Geotechnical Investigation and Acid Sulfate Soil Assessment by STS Geotechnics Pty Ltd Project No: 32630/8546D-G, dated April 2024.

Based on the latest drawings and further communications with the client, Alliance understands that the proposed development includes the construction of a residential flat building ranging between three and eight storeys high with a total of 126 social and affordable housing apartments. It is understood that no basement levels are proposed, thus it is anticipated that excavations at the site will be limited to site preparation works for footings.

The objectives of this Geotechnical Investigation Report were to assess the subsurface conditions of the site and provide a Geotechnical Investigation Report (GIR) with comments and recommendations to the following:

- Geotechnical and groundwater conditions.
- Geotechnical design parameters required for foundation system and retaining wall design.
- Footing options and foundation layer.
- Excavation conditions and vibrations.
- Temporary and/or permanent retention and batter slopes.
- Site preparation.

This report is required to assist the client to address development consent decision making processes set out in State Environmental Planning Policy (SEPP) Resilience and Hazards 2021 and condition 13 (geotechnical assessment) of the Planning Secretary's Environmental Assessment Requirements (SEARs) for development within identified sites and precincts, issued on the 24 July 2024, application number SSD-72393459.

1.1 Site Description

The site is located at 792-794 Botany Road and 33-37 Henry Kendal Crescent, Mascot and is located within Bayside Local Government Area (LGA).

The site has a total site area of 4,904 square meters (sqm) and has three street frontages; Henry Kendall Crescent to the west, Coward Street to the south and Botany Road to the east.

The site comprises 25 social housing dwellings within five two-storey brick buildings including three walkup apartments buildings, a NSW Ambulance depot, and two town house style buildings which were constructed in the 1960s. There are a number of mature street trees located along Botany Road, Coward Street and Henry Kendall Crescent. Refer to **Figure 1**.

The site is located opposite Mascot Memorial Park on Coward Street, a large public park which provides a range of passive and active recreation, including children's playground, formal gardens, and tennis courts.

The site is accessible by public transport (buses and trains) with frequent bus services that run along Botany Road. Mascot Train Station is also located within 850m of the site.



Figure 1 - Site Location & Aerial Image

2 PROPOSED DEVELOPMENT

The proposed development comprises demolition of existing buildings and construction of a residential flat building ranging in height between three and eight storeys to accommodate 126 social and affordable housing apartments, a ground-level car parking, tree removal and associated landscaping and public domain works.

It is understood that no basement levels are proposed, thus it is anticipated that excavations at the site will be limited to site preparation works for footings.

3 REGIONAL GEOLOGY

The New South Wales Seamless Geology dataset, version 2.4 [Digital Dataset] published by the Geological Survey of New South Wales, indicates that the site is underlain by Coastal Deposits, which are Marine-deposited and aeolian-reworked coastal sand dunes.

The site overlaying NSW Seamless Geology with 10m contours map is presented in **Figure 2** below.



Figure 2 - Site Location with NSW Seamless Geology with 10m contours

4 FIELDWORK

4.1 Methods

The geotechnical investigation was carried out on 26 June 2024. The investigation comprised the probing of three Cone Penetrometer Tests (CPTs), followed by engineering analysis and reporting. Details of the field investigation are presented in this report, together with comments and recommendations pertinent to the development.

The CPT locations were confirmed on-site, checked against available Before You Dig Australia (BYDA) plans and cleared by a subcontracted service locator of underground services prior to drilling.

CPTs were undertaken using a subcontracted track mounted CPT rig to a nominal depth of 15.0m or prior probe refusal. Where early refusal was encountered, the CPT hole was augured using a 150mm diameter augur in an attempt to allow deeper probing.

At completion, the holes were backfilled with drilling spoil and generally made flush with the surrounding surface.

4.2 Investigation Details

A summary of the geotechnical site investigation at each CPT location and approximate coordinates are presented in Table 1 below. The coordinates provided above are approximate and should be used as a reference only and a registered surveyor must be engaged if detailed survey is required for design purposes.

Table 1 - Summary of surveyed investigation locations, termination depths and reduced levels (RL)

ID	Easting (m GDA2020 MGA Zone 56)	Northing (m GDA2020 MGA Zone 56)	Practical Refusal Depth	Surface RL
			m bgl	m AHD
CPT01	333135	6244662	6.84	8.03
CPT02	333142	6244723	7.11	8.21
CPT03	333178	6244654	7.64	8.40

The approximate CPT locations are shown on the CPT Location Plan (Drawing 17716.3-GR-1-1-A) presented in Appendix B.

4.3 Encountered Subsurface Conditions

Summarised descriptions of the encountered subsurface geotechnical units are provided in Table 2. Based on the findings of this investigation and STS geotechnical investigation report, medium dense to very dense sand extends from between 2.50 and 3.20 mbgl to between 19.50 to 21.20 mbgl, underlain by Silty / Sandy Clay up to between 28.5 and 30.0 mbgl underlain by Sandstone bedrock.

Table 2 - Summary of Encountered Subsurface Profiles

Ground Profile ¹	Density	CPT01 (m bgl)	CPT02 (m bgl)	CPT03 (m bgl)
Coastal Deposits: predominantly Sand and Silty SAND ²	Very Loose - loose	0.00 – 3.00 3.30 – 3.60	0.00 – 2.50 4.00 – 4.10	0.00 – 3.20
	Medium Dense	3.00 – 3.30 3.60 – 4.10	2.50 – 4.00 4.10 – 4.30	3.20 – 3.80
	Dense	4.10 – 4.50	4.30 – 5.50	3.80 – 5.60
	Very Dense	4.50 – 6.84	5.50 – 8.21	5.60 – 8.40 ³

Notes:

- ¹ Material origin inferred from CPT, not visual or tactile observations.
- ² With interlaminated / interbedded layers of clay / silty clay up to 0.20m thick encountered in CPT01.
- ³ With and interbedded layer of sand with lower density encountered between 6.4m and 6.8m bgl.

Reference to the individual CPT log sheets should be made for a full description of the subsurface conditions encountered at each borehole. These results should be read in conjunction with the attached Explanatory Notes which explain the terms, abbreviations, and symbols used, together with the interpretation and limitation of the logging procedure.

4.4 Groundwater

Groundwater was encountered with varying depths within the soil profile based on CPT logs interpretation as shown in Table 3, below. It should be noted that groundwater seepage condition is subject to seasonal and climatic conditions and may vary across the site.

Table 3 - Summary of Groundwater Levels

Location ID	Groundwater Level (m bgl)
CPT01	2.2
CPT02	3.2
CPT03	2.6

5 COMMENTS & RECOMMENDATIONS

5.1 Recommended Preliminary Material Strength Parameters

Based on the interpreted CPT data, the preliminary material strength parameters are provided in Table 4 below.

Table 4 - Recommended Material Strength Parameters

Material ¹	Unit Weight (kN/m ³) ²	Undrained shear strength (kPa)	Friction Angle (°) ³	Cohesion (kPa)	Earth Pressure Coefficients			Young's Modulus (MPa) ⁴	Poisson's Ratio
					Active	At Rest	Passive		
					(K _a)	(K _o)	(K _p)		
		C _u	Φ	c'				E _h	ν
Coastal Deposit Sand (Very Loose)	16	0	27	0	0.38	0.55	2.66	5	0.3
Coastal Deposit Sand (Loose)	18	0	30	0	0.33	0.50	3.00	10	0.3
Coastal Deposit Sand (Medium Dense)	19	0	32	0	0.31	0.47	3.25	35	0.3
Coastal Deposit Sand (Dense)	20	0	35	0	0.28	0.44	3.54	60	0.3
Coastal Deposit Sand (Very Dense)	21	0	38	0	0.24	0.38	4.20	100	0.3

Notes:

- ¹ Refer to Table 1 for layer depths at CPT locations and CPT logs in Attachment C for material description details and depths.
- ² *In-situ* unit weight, based on visual assessment only (± 2 kN/m³).
- ³ Internal friction angle ($\pm 2^\circ$) assuming drained conditions.
- ⁴ Effective Elastic Modulus ($\pm 10\%$).

5.2 Excavation Conditions

The following recommendations should be read in conjunction with the latest version of "Excavation Work Code of Practice" prepared by Safework NSW.

Excavations for the proposed development are anticipated to be limited to site preparation works for footing construction.

Based on the subsurface conditions encountered and summarised in Table 2, shallow depth excavations are expected to encounter sand ranging in density from very loose to loose.

Excavations through the sand is expected to be readily achieved using conventional earthworks equipment such as a tracked excavator with tiger toothed bucket.

As bedrock is not expected to be encountered within the anticipated depth of excavation, the level of vibrations during excavations should not be an issue on this project.

A dilapidation survey on nearby structures and infrastructures is recommended to be undertaken by a structural engineer prior to the commencement of any site excavations. The report should include precise measurements of the existing defects and cracks presented with the relevant photos.

5.3 Foundation System and Design Parameters

Due to the presence of loose cohesionless soils at the site down to 4.0m depths, pier footings in the form of cased bored piles or CFA piles should be adopted for the proposed development. The recommended design parameters for the deep foundations are presented in Table 5 below.

Should greater bearing capacities be required the piles can be socketed into bedrock which ranges from depths of 28.5 m to 30.0 m based on the STS geotechnical investigation report.

Table 5 - Pile Design Parameters

Material Description	Allowable Bearing Capacity ¹⁻⁴ (kPa)	Allowable Shaft Adhesion ¹⁻⁴ (kPa)
Medium Dense Sand	400	10
Dense Sand	1,400	15
Very Dense Sand	2,000	20

Notes:

- 1 These parameters are to be confirmed during the construction works.
- 2 Allowable end bearing capacities and shaft adhesions provided considering a factor of safety of 3.
- 3 Assumed a pile diameter of 600mm and minimum pile embedment depth of 3 pile diameter into the design socket material.
- 4 Assumed worst case groundwater at surface level.

The allowable bearing capacity should be adopted based on the tolerable settlement, following finalising of the footings' dimensions based on the applied structural loads.

Continuous Flight Auger (CFA) piles are considered a suitable piling method due to the sandy nature of the material and groundwater conditions on this Site. Conventional open bore piles are not recommended due to high level groundwater and potentially collapsing sand, for which even installation of temporary casing is likely to prove difficult.

If cased bored piles are adopted, pile holes are required to be cleaned of any loose or disturbed material and any water immediately prior to placing the concrete.

Inspection of the footing excavations should be carried out by an experienced geotechnical engineer or engineering geologist to confirm the founding strata and design embedment depth in accordance with recommendations made in this report.

5.4 Site Preparation and Earthworks

The results of the fieldwork indicate that sand material below the topsoil could be reused on site if required provided any organic or deleterious materials are removed.

All filling material should be placed in layers not exceeding 300 mm maximum loose thickness and the material moisture conditioned to be within 2% of Optimum Moisture Content (OMC) by the addition or removal of water, as appropriate. Each layer should be compacted by rolling to a density ratio not less than 95% standard compaction or 98% beneath structures and 100% for the top 300mm layer of subgrade.

Methods of maintaining moisture content may include the use of plastic membranes or gravel layers over the surface of the exposed subgrade or lime blending within the upper subgrade layers. Maintaining correct moisture content within the subgrade will be assisted if there are minimal delays in construction of ground slabs and pavements after completion of earthworks.

Further advice should be sought if filling is required to support major structures. Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate reuse or disposal to an appropriately licensed landfill facility.

6 LIMITATIONS

Alliance has prepared this report for the site located at 792-794 Botany Rd and 33-37 Henry Kendal Crescent, Mascot NSW in accordance with Alliance's fee proposal and Terms of Engagement.

Copyright in all and every part of this document belongs to Alliance Geotechnical Pty Ltd ('Alliance'). The document must not be used, sold, transferred, copied or reproduced in whole or in part in any form or manner or in or on any media to any person other than as allowed by the terms of the engagement between Alliance and the name client or as otherwise agreed to by Alliance in writing.

This document is produced by Alliance solely for the use and benefit by the named client and its delivery partners in accordance with the terms of the engagement between Alliance and the name client. Alliance (and the document reviewer if applicable) does not and shall not assume any liability or responsibility whatsoever to any third party arising out of any use or reliance by any third party on the content of this document. For the avoidance of doubt, "third party" does not include the named client or its delivery partners, in accordance with the engagement between Alliance and the named client.

The comments and recommendations provided in this report are based on the assumption that the geotechnical recommendations contained in this report will be fully complied with during the design and construction of the proposed site development.

The cone penetrometer results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths excavated at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

7 REFERENCES

Colquhoun G.P., Hughes K.S., Deyssing L., Ballard J.C., Folkes C.B, Phillips G., Troedson A.L. & Fitzherbert J.A. 2021. New South Wales Seamless Geology dataset, version 2.1 [Digital Dataset]. Geological Survey of New South Wales, Department of Regional NSW, Maitland.

AS1726-1993 – Geotechnical Site Investigations

AS3789-2007 – Guidelines on earthworks for commercial and residential developments.

APPENDIX A – Site Photograph



Photo 1 – Drilling set-up near CPT01



Photo 2 – CPT02 Location

APPENDIX B – Geotechnical Investigation Plan (Drawing 17716.3-GR-1-1-A)



Site Locality



Client Name:	Homes NSW
Project Name:	Proposed Large Tenure Developments
Project Location:	792-794 Botany Rd and 33-37 Henry Kendal Crescent, Mascot NSW

Figure Number:	17716.3-GR-1-1-A
Figure Date:	22/07/2024
Report Number:	17716.3-GR-1-1



APPENDIX C – Explanatory Notes, Interpreted CPT Logs

GENERAL

Information obtained from site investigations is recorded on log sheets. Soils and very low strength rock are commonly drilled using a combination of solid-flight augers with a Tungsten-Carbide (TC) bit. Descriptions of these materials presented on the "Borehole Log" are based on a combination of regular sampling and in-situ testing. Rock coring techniques commence once material is encountered that cannot be penetrated using a combination of solid-flight augers and Tungsten-carbide bit. The "Cored Borehole Log" presents data from drilling where a core barrel has been used to recover material - commonly rock.

The "Excavation – Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits or trenches.

The heading of the log sheets contains information on Project Identification, Hole or Test Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material 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 scale is presented in the depth column as metres below ground level.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is included 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, and geological unit. Material description and classifications are based on Australian Standard Geotechnical Site Investigations: AS 1726 - 2017 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 and Excavating

Drilling methods deployed are abbreviated as follows

Abbreviation	Method
AS	Auger Screwing
ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
BH	Backhoe
E	Excavator
HA	Hand Auger
HQ	HQ core barrel (~63.5 mm diameter core) *
HMLC	HMLC core barrel (~63.5 mm diameter core) *
NMLC	NMLC core barrel (~51.9 mm diameter core) *
NQ	NQ core barrel (~47.6 mm diameter core) *
RR	Rock Roller
WB	Wash-bore drilling

* Core diameters are approximate and vary due to the strength of material being drilled.

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage. It is introduced to assist with the drill process, in particular, when core drilling. The introduction of drill fluid/water does not allow for accurate identification of water seepages.

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:

Abbreviation	Description
VE	Very Easy
E	Easy
F	Firm
H	Hard
VH	Very Hard

GROUNDWATER LEVELS

Date of measurement is shown.

- Standing water level measured in completed borehole
- Level taken during or immediately after drilling
- Groundwater inflow water level

SAMPLES/TESTS

Samples collected and testing undertaken are abbreviated as follows

Abbreviation	Test
ES	Environmental Sample
DS	Disturbed Sample
BS	Bulk Sample
U50	Undisturbed (50 mm diameter)
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test
HB	Hammer Bouncing

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. Photos are recommended.

MATERIAL DESCRIPTION – SOIL

Material Description - In accordance with AS 1726-2017

Classification Symbol - In accordance with the Unified Classification System (AS 1726-2017).

Abbreviation	Typical Name
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands, gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures.
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity. *
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, clastic silts.
CH	Inorganic clays of high plasticity, fat clays.
OH	Organic clays of medium to high plasticity, organic silts. *
Pt	Peat and other highly organic soils. *

* Additional details may be provided in accordance with the Von Post classification system (1922).

Organic Soils – Identification using laboratory testing:

Material	Organic Content - % of dry mass
Inorganic	<2
Organic Soil	<2 ≤ 25
Peat	> 25

Organic Soils – Descriptive terms for the degree of decomposition of peat:

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water No solid
Pseudo-fibrous	Moderate	Mixture of fibrous and amorphous	Turbid water < 50% solids
Amorphous	Full	Not recognizable	Paste > 50% solids

Particle Characteristics – Definitions are as follows:

Fraction	Component (& subdivision)		Size (mm)
Oversize	Boulders		> 200
	Cobbles		> 63 ≤ 200
Coarse grained soils	Gravel	Coarse	> 19 ≤ 63
		Medium	> 6.7 ≤ 19
		Fine	> 2.36 ≤ 6.7
	Sand	Coarse	> 0.6 ≤ 2.36
		Medium	> 0.2 ≤ 0.6
		Fine	> 0.075 ≤ 0.21
Fine grained soils	Silt		0.002 ≤ 0.075
	Clay		< 0.002

Secondary and minor soil components

In coarse grained soils – The proportions of secondary and minor components are generally estimated from a visual and tactile assessment of the soils. Descriptions for secondary and minor soil components in coarse grained soils are as follows.

Designation of components	Percentage fines	Terminology (as applicable)	Percentage accessory coarse fraction	Terminology (as applicable)
Minor	≤ 5	Trace clay / silt	≤ 5	Trace sand / gravel
	> 5 ≤ 12	With clay / silt	> 5 ≤ 12	With sand / gravel
Secondary	> 12	Silty or clayey	> 30	Sandy or gravelly

Descriptions for secondary and minor soil components in fine grained soils are as follows.

Designation of components	Percentage coarse grained soils	Terminology (as applicable)
Minor	≤ 5	Trace sand / gravel / silt / clay
	> 5 ≤ 12	With sand / gravel / silt / clay
Secondary	> 30	Sandy / gravelly / silty / clayey

Plasticity Terms - Definitions for fine grained soils are as follows:

Descriptive Term	Range of Liquid Limit for silt	Range of Liquid Limit for clay
Low Plasticity	≤ 50	≤ 35
Medium Plasticity	N/A	> 35 ≤ 50
High Plasticity	> 50	> 50

Particle Characteristics

Particle shape and angularity are estimated from a visual assessment of coarse-grained soil particle characteristics. Terminology used includes the following:

Particle shape – spherical, platy, elongated,

Particle angularity – angular, sub-angular, sub-rounded, rounded.

Moisture Condition – Abbreviations are as follows:

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

Moisture content of fine-grained soils is based on judgement of the soils moisture content relative to the plastic and liquid limit as follows:

MC < PL	Moist, dry of plastic limit.
MC ≈ PL	Moist, near plastic limit.
MC > PL	Moist, wet of plastic limit.
MC ≈ LL	Wet, near liquid limit.
MC > LL	Wet of liquid limit.

Consistency - of cohesive soils in accordance with AS 1726-2017, Table 11 are abbreviated as follows:

Consistency Term	Abbreviation	Indicative Shear Strength (kPa)	Undrained Strength Range
Very Soft	VS		< 12
Soft	S		12 ≤ 25
Firm	F		25 ≤ 50
Stiff	St		50 ≤ 100
Very Stiff	VS_t		100 ≤ 200
Hard	H		≥ 200
Friable	Fr		-

Density Index (%) of granular soils is estimated or is based on SPT results. Abbreviations are as follows:

Description	Abbreviation	Relative Density	SPT N
Very Loose	VL	< 15%	0 - 4
Loose	L	15 - 35%	4 - 10
Medium Dense	MD	35 - 65%	10 - 30
Dense	D	65 - 85%	30 - 50
Very Dense	VD	> 85%	> 50

Structures – Fissuring and other defects are described in accordance with AS 1726-2017 using the terminology for rock defects

Origin – Where practicable an assessment is provided of the probable origin of the soil, e.g. fill, topsoil, alluvium, colluvium, residual soil.

MATERIAL DESCRIPTION - ROCK

Material Description – In accordance with AS 1726-2017

Rock Naming – Where possible conventional geological names are used within the logs. Engineering properties cannot be inferred directly from the rock names in the table, but the use of a particular name provides an indicative range of characteristics to the reader. Lithological identification of rock is provided to appreciate the geology of an area, to correlate geological profiles seen in boreholes or to distinguish boulders from bedrock.

Grain Size – Grain size is done in accordance with AS1726-2017 as follows:

For sedimentary rock:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm to 0.2mm

For igneous and metamorphic rock:

Coarse grained	Mainly greater than 2 mm
Medium grained	Mainly 0.6mm to 2mm
Fine grained	Mainly less than 2mm

Colour - Rock colour is described in the moist condition.

Texture and Fabric

Frequently used terms:

Sedimentary Rock	Metamorphic Rock	Igneous
Bedded	Banded	Amorphous
Cross-bedded	Cleaved	Crystalline
Folded	Folded	Flow banded
Graded	Foliated	Folded
Interbedded	Gneissose	Lineated
Laminated	Lineated	Massive
Massive	Schistose	Porphyritic

Bedding and fabric:

Description	Spacing
Very Thickly Bedded	> 2m
Thickly Bedded	0.6m to 2m
Medium Bedded	0.2m to 0.6m
Thinly Bedded	60mm to 200mm
Very Thinly Bedded	20mm to 60mm
Thickly Laminated	6mm to 20mm
Thinly Laminated	< 6mm

Degree of development:

Massive	No layering or fabric. Rock is homogeneous.
Indistinct	Layering or fabric just visible, There is little effect on strength properties.
Distinct	Layering or fabric obvious. The rock may break more easily parallel to the fabric.

Features, inclusions, and minor components - Features, inclusions and minor components within the rock material shall be described where those features could be significant such as gas bubbles, mineral veins, carbonaceous material, salts, swelling minerals, mineral inclusions, ironstone or carbonate bands, cross-stratification, or minerals the readily oxidise upon atmospheric exposure.

Moisture content - Where possible descriptions are made by the feel and appearance of the rock using one according to following terms:

Dry	Looks and feels dry.
Moist	Feels cool, darkened in colour, but no water is visible on the surface.
Wet	Feels cool, darkened in colour, water film or droplets visible on the surface.

The moisture content of rock cored with water may not be representative of its in-situ condition.

Durability – Descriptions of the materials durability such as tendency to develop cracks, break into smaller pieces or disintegrate upon exposure to air or in contact with water are provided where observed.

Rock Material Strength – The strength of the rock material is based on uniaxial compressive strength (UCS). The following terms are used:

Term / Abbreviation	Description	UCS (MPa)	Point Load Strength Index (MPa)	
Very Low	VL	Crumbles under firm blow with sharp end of pick, can be peeled with a knife; too hard to cut a triaxial by hand; 30mm pieces can be broken by hand.	0.6 – 2	0.03 – 0.1
Low	L	Easily scored with a knife; indentations 1-3mm show with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	2 – 6	0.1 – 0.3
Medium	M	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.	6 – 20	0.3 – 1
High	H	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	20 – 60	1 – 3
Very High	VH	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 – 200	3 – 10
Extremely High	EH	Specimen requires many blows with geological pick to break into intact materials; rock rings under hammer.	> 200	> 10

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

D Diametral Point Load Test
A Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown. Point Load Strength Index test results are presented as $I_{s(50)}$ values in MPa.

Weathering – Weathering classification assists in identification but does not imply engineering properties. Descriptions are as follows:

Term / Abbreviation	Description	
Residual Soil	RS	Material has soil properties. Mass structure and material texture and fabric of original rock not visible, but the soil has not been significantly transported.
Extremely Weathered	EW	Material has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	HW	Material is completely discoloured, significant decrease in strength from fresh rock.
Moderately Weathered	MW	Material is completely discoloured, little or no change of strength from fresh rock.
Slightly Weathered	SW	Partly stained or discoloured, little or no change to strength from fresh rock.
Fresh	FR	No signs of mineral decomposition or colour change.

Alteration – Physical and chemical changes of the rock material due to geological processes by fluids at depth at pressures and temperatures above atmospheric conditions. Unlike weathering, alteration shows no relationship to topography and may occur at any depth. When altered materials are recognized, the following terms are used:

Term / Abbreviation		Description
Extremely Altered	XA	Material has soil properties. Structure, texture, and fabric of original rock are still visible. The rock name is replaced with the name of the parent material, e.g., Extremely Altered basalt. Soil descriptive terms are used.
	HA	The whole of the rock material is discoloured. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be higher or lower due to loss of minerals or precipitation of secondary minerals in pores.
Highly Altered	DA	The whole of the rock material is discoloured. Little or no change of strength from fresh rock. The term 'Distinctly Altered' is used where it is not practicable to distinguish between 'Highly Altered' and 'Moderately Altered'. Distinctly Altered is defined as follows: - The rock may be highly discoloured; - Porosity may be higher due to mineral loss; or may be lower due to precipitation of secondary minerals in pores; and - Some change of rock strength.
Moderately Altered	DA	
Slightly Altered	S	Rock is slightly discoloured. Little or no change of strength from fresh rock.

Alteration is only described in the context of the project where it has relevance to the civil and structural design.

Defect Descriptions

General and Detailed Descriptions – Defect descriptions are provided to suit project requirements. Generalized descriptions are used for some projects where it is unnecessary to describe each individual defect in a rock mass, or where multiple similar defects are present which are too numerous to log individually. The part of the rock mass to which this applies is delineated.

Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided where it is possible to do so.

Defect Type – Defect abbreviations are as follows:

BP	Bedding parting	SSM	Sheared seam	DB	Drilling break
JT	Joint	CS	Crushed seam	HB	Handling break
SS	Shear surface	SM	Infilled seam		
SZ	Sheared zone	EWS	Extremely weathered seam		

Sheared surfaces, sheared zones, sheared seams, and crushed seams are generally faults in geological terms.

Defect Orientation

For oriented core: The dip and dip direction are recorded as a two-digit and three-digit number separated by a slash, are collected e.g., 50°/240° and there is not core loss that could obscure core orientation. If alternative measurements are made, such as dip and strike or dip direction relative to magnetic north this shall be documented.

For non-oriented core: The dip is recorded as a two-digit number, e.g., 10°. In vertical boreholes the dip is generally measured relative to the horizontal plan. If the borehole is inclined the dip is generally measured from the core axis.

Surface Roughness – Defect surface roughness is described as follows:

VR	Very rough	Many large surface irregularities with amplitude generally more than 1 mm.
RO	Rough	Many small surface irregularities with amplitude generally less than 1 mm.
SO	Smooth	Smooth to touch. Few or no surface irregularities.
PO	Polished	Shiny smooth surface
SK	Slickensided	Grooved or striated surface, usually polished.

Surface Shape – Defect surface roughness is described as follows:

PL	Planar	The defect does not vary in orientation.
CU	Curved	The defect has a gradual change in orientation
UN	Undulating	The defect has a wavy surface.
ST	Stepped	The defect has one or more well defined steps
IR	Irregular	The defect has many sharp changes of orientation

Defect Infilling – Common abbreviation as follows:

Ca	Calcite	Fe	Iron Oxide	Qz	Quartz
Cy	Clay	MS	Secondary mineral	X	Carbonaceous

Defect Coatings and Seam Composition - Coatings are described using the following terms:

CN	Clean	No visible coating.
SN	Stained	No visible coating but surfaces are discoloured.
VN	Veneered	A visible coating of soil or mineral, too thin to measure; may be patchy.
CO	Coating	A visible coating up to 1 mm thick. Soil in-fill greater than 1 mm shall be described using defect terms (e.g., infilled seam). Defects greater than 1 mm aperture containing rock material great described as a vein.

Defect Spacing, Length, Openness and Thickness – Described directly in millimetres and metres. In general descriptions, half order of magnitude categories is used, e.g. joint spacing typically 100 mm to 300 mm, sheared zones 1m to 3m thick.

Depending on project requirements and the scale of observation, spacing may be described as the mean spacing within a set of defects, or as the spacing between all defects within the rock mass. Where spacing is measured within a specific set of defects, measurements shall be made perpendicular to the defect set.

Where significant, the nature of the defect end condition is recorded in the context of the scale of the exposure.

Block Shape – Where it is considered significant, block shape should be described using terms given in Table 23, AS 1725:2017.

Stratigraphic Unit – Geological maps related to the project are used for the designation of lithological formation name and, where possible geological unit name, e.g., Bringelly Shale, Potts Hill Sandstone Member.

Core Loss – Core loss occurs when material is lost during the drilling process It is shown at the bottom of the run unless otherwise indicated where core loss is known.

Total Core Recovery – The percentage of rock recovered excluding core loss per core run.

Defect Spacing – The spacing of successive defects or the mean spacing for relatively broken core.

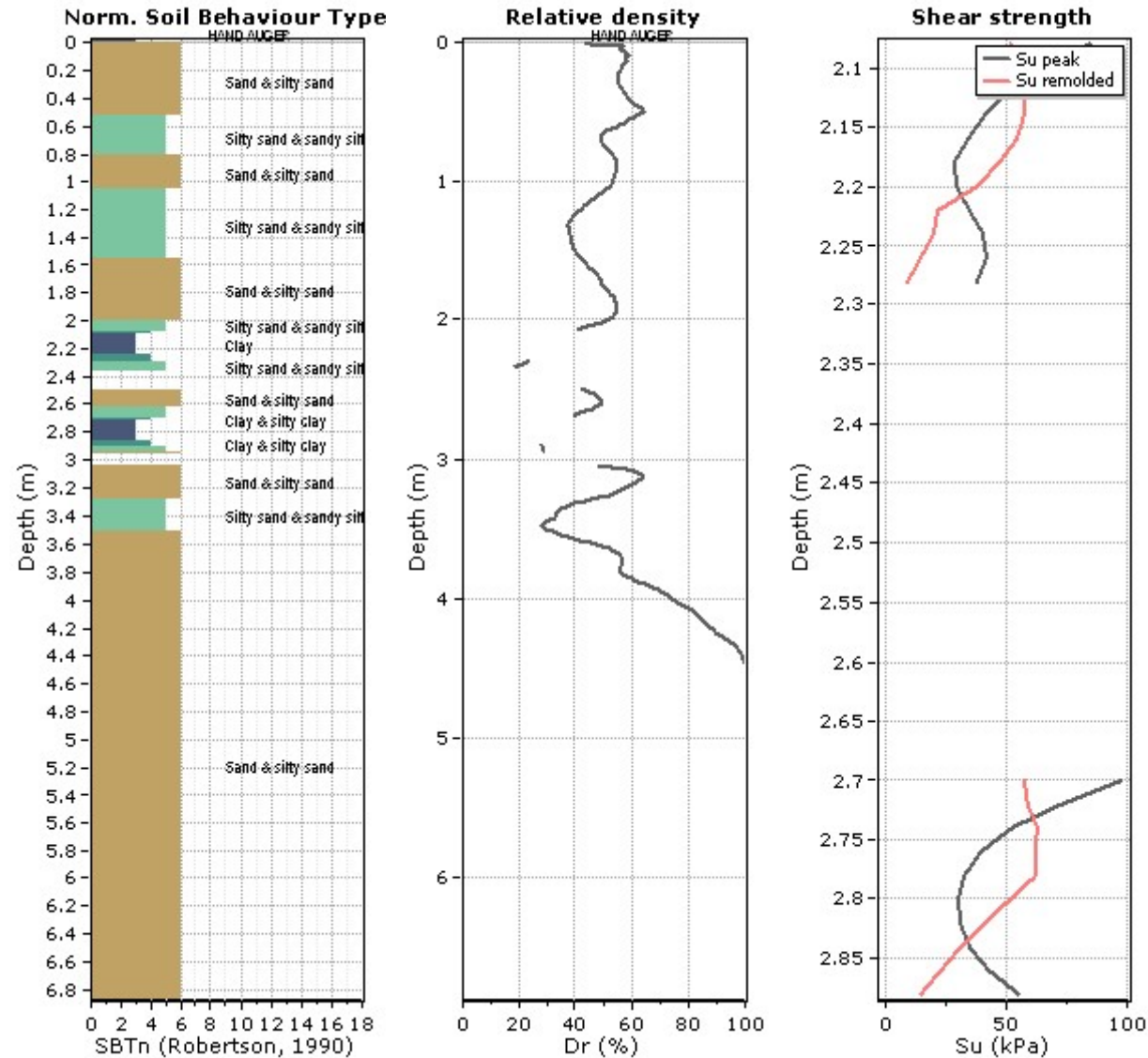
Fracture Index – Which is the number defects per metre of core.

Rock Quality Designation (RQD) – The percentage of sound core pieces of 100mm or greater per core run and is calculated using Deere et al. (1989) method.

Rock Classification System – For design purpose, Sydney Rock Mass Classification System (Pells et al. 1998, 2019) is adopted.

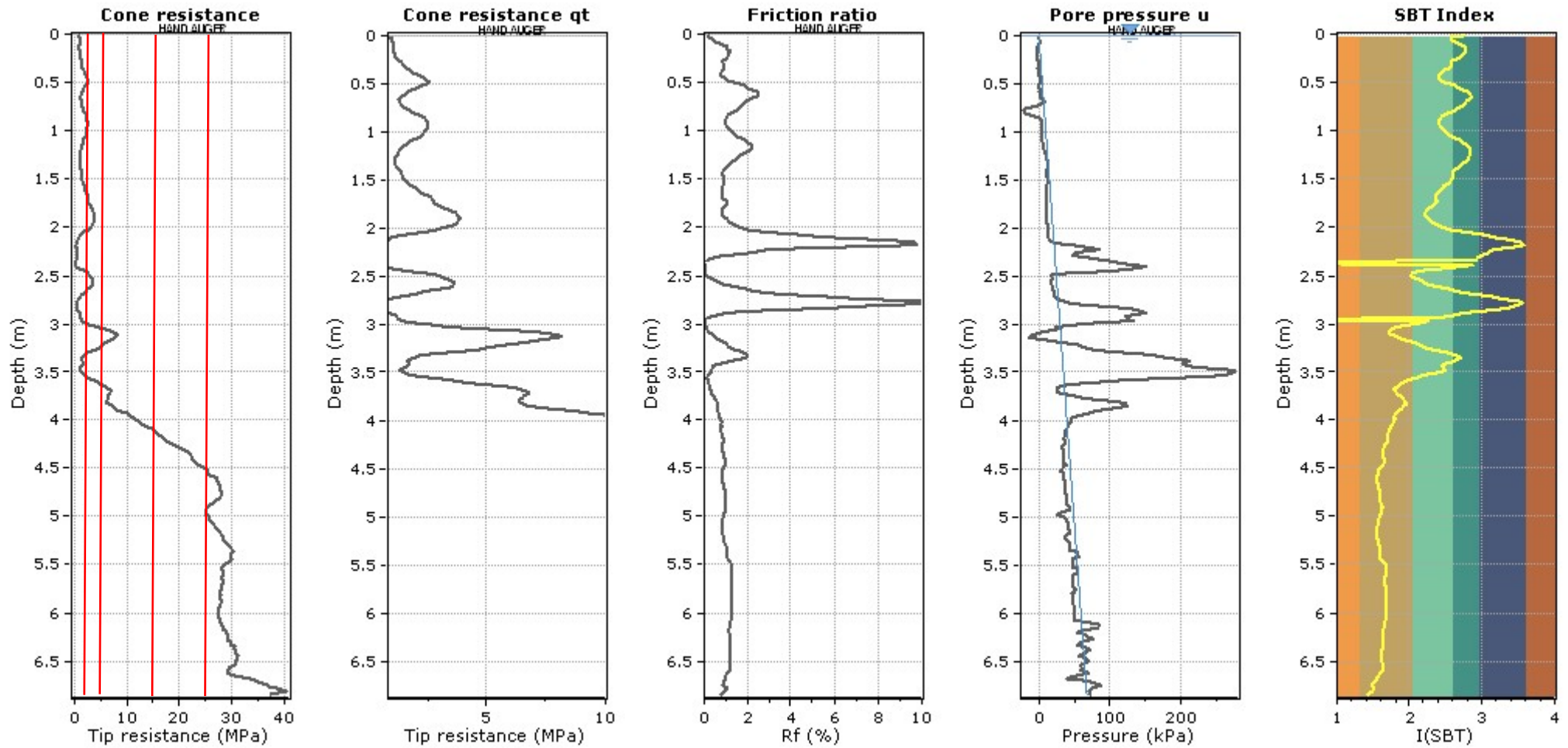
Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW



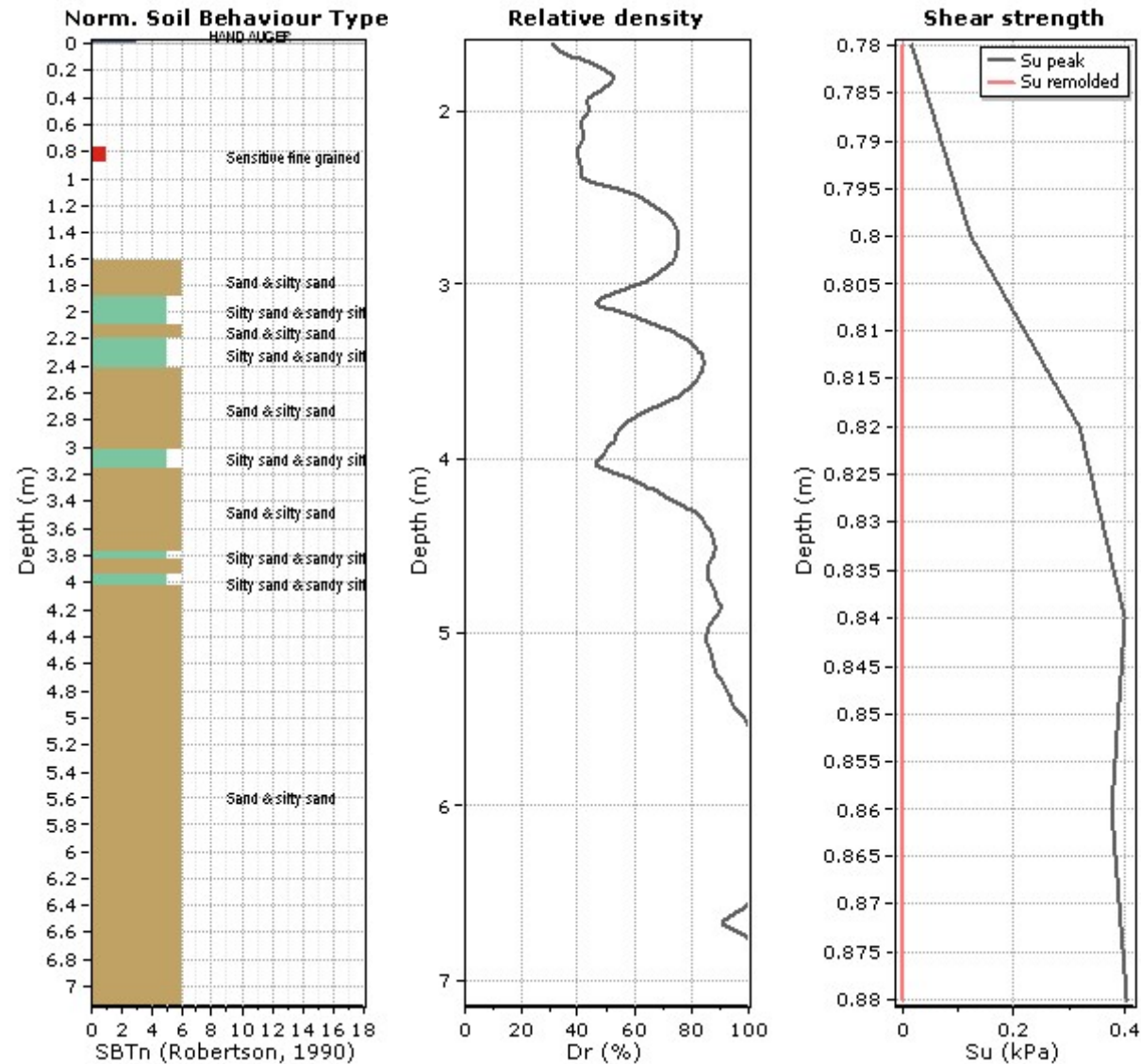
Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW



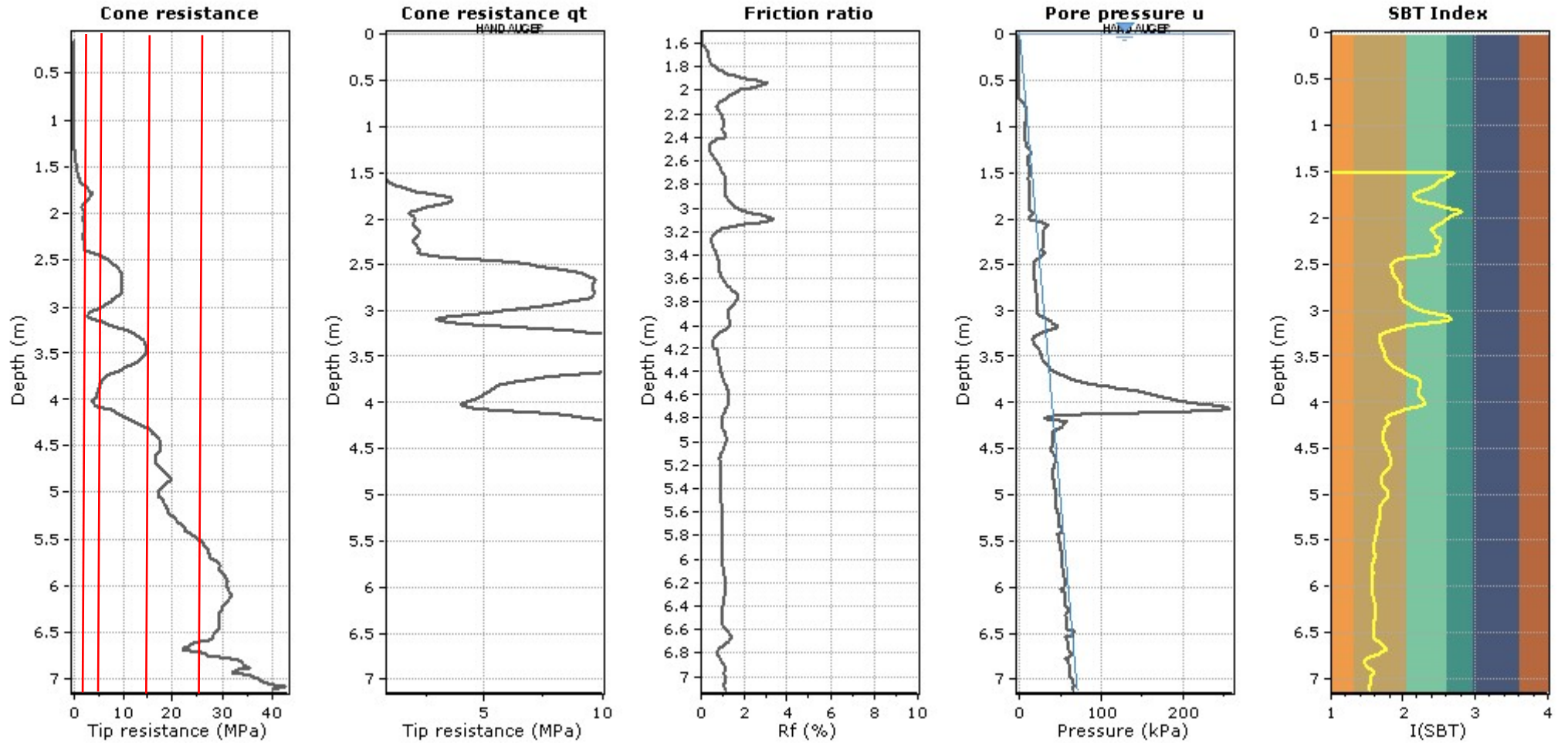
Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW



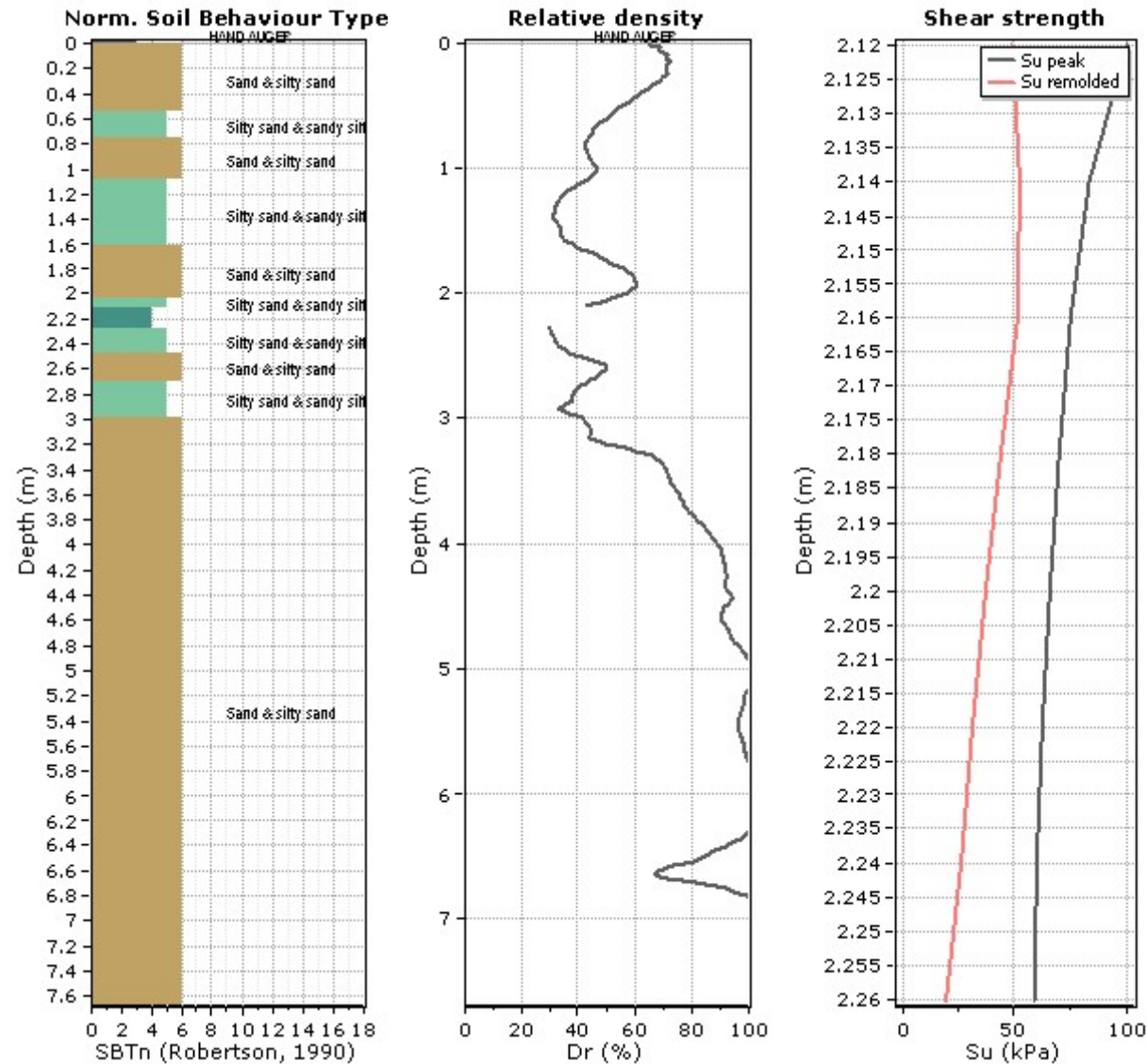
Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW



Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW



Project: Proposed Large Tenure Developments

Location: Botany Rd & Henry Kendal Crescent, Mascot NSW

