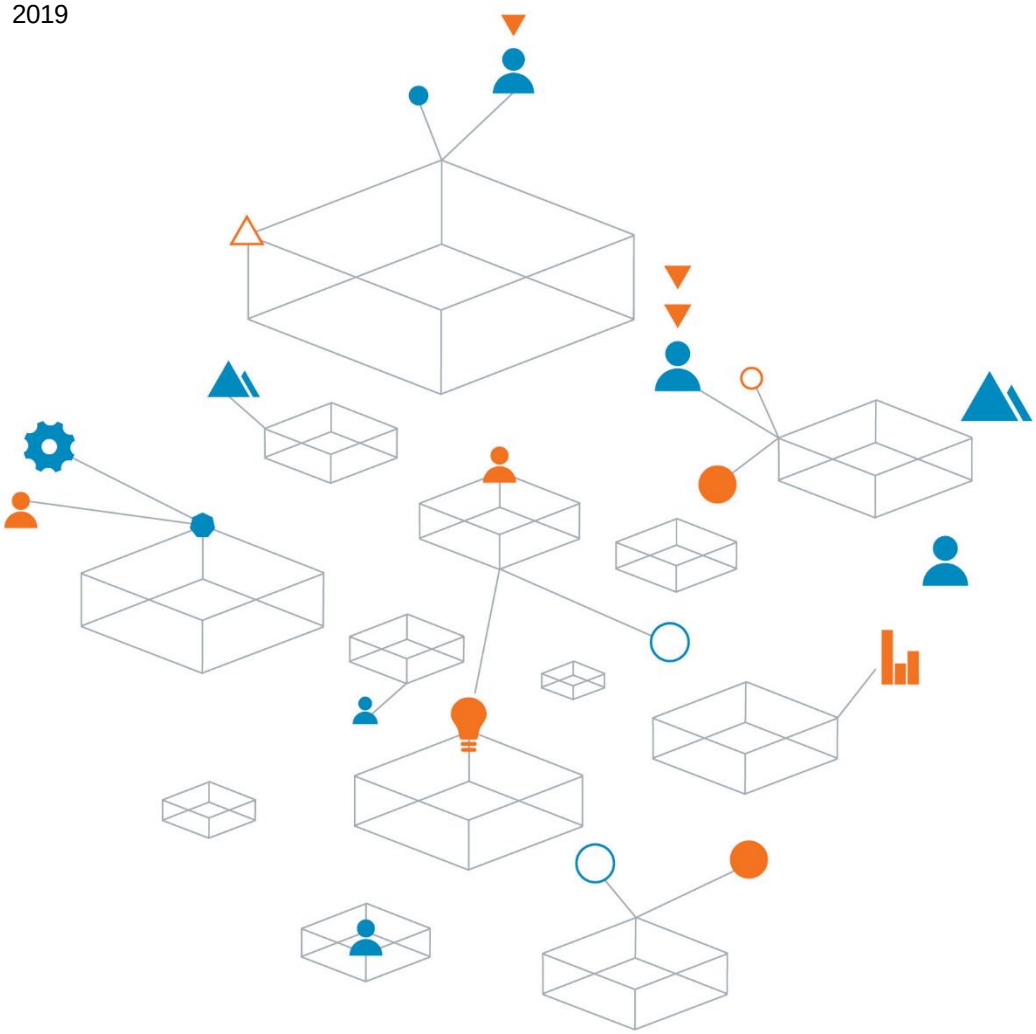
Crescent Newcastle Pty Ltd
Proposed Multi - Building Residential Development
11-17 Mosbri Crescent, Cooks Hill NSW 2300
Preliminary Geotechnical Report
754-NTLGE220504-AG.Rev3

14 January 2019



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Preliminary Geotechnical Report - Proposed Multi - Building Residential Development 11-17 Mosbri Crescent, Cooks Hill NSW 2300

Prepared for
Crescent Newcastle Pty Ltd

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Quality information

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1. Introduction

Coffey Services Australia Pty Ltd (Coffey) was commissioned by Crescent Newcastle Pty Ltd (Crescent) to carry out a geotechnical investigation for the proposed multi building residential development located at 11-17 Mosbri Crescent, The Hill, NSW.

This report addresses the geotechnical scope of work outlined in our proposal referenced as 754-NTLGE220504.P01.Rev02, Section 2.3 Geotechnical, dated 27 August 2018. Preliminary contamination assessment and mine subsidence investigations will be reported separately.

The currently proposed development will include:

- Construction of residential accommodation comprising 172 dwellings, being:
  - Eleven (11) two storey townhouse style dwellings fronting Mosbri Crescent, located above a basement car park containing 34 visitor spaces and 11 resident spaces;
  - Three (3) residential flat buildings (Building A, B, and C) containing 161 dwellings, ranging from one to three bedrooms; being
    - Building A including a nine (9) storey east wing and six (6) storey west wing;
    - Building B comprising seven (7) storeys and a roof top communal open space, with (9) town house style dwellings facing the internal courtyard;
    - Building C comprising five (5) levels;
- Interconnected car parking for Building A, B & C located on the ground floor and first level, contains 1 visitor spaces and 196 resident spaces;
- Pedestrian path, providing connection from Mosbri Crescent to Kitchener Parade; and
- Associated landscaping, communal open space, services and site infrastructure.

Site is sloping south westerly towards Mosbri Crescent Reserve and existing ground RLs within the footprint of the Building A, B and C varies between RL 26m AHD and RL 38.00m AHD. The combined basement levels will require excavation of up to approximately 8.5m to 9.5m below existing ground level (RL 28.10m AHD and RL 29.60m AHD) at the rear (eastern) side of the property although the proposed excavation is generally less that 4m (from less than RL 32m AHD current levels down to the RL 28.1m AHD proposed).

Two storey townhouses are proposed along Mosbri Crescent with single basement level. Maximum excavation required for the proposed townhouses will be approximately 4.5m below ground level (proposed basement RL 25.40m AHD to RL 28.20m AHD from current surface levels of RL 27.2m AHD to RL 32m AHD).

Vehicular access to the proposed development is via ramp from Mosbri Crescent connecting with proposed basements driveways, located next to apartment building located at 9 Mosbri Crescent, north western side of site.

Prior to this report Coffey was given following documents:

- Site Survey Plan prepared by Monteath & Powys Pty Ltd, titled as “Detail Survey Over Lot 1 DP204077, NBN Studios, Mosbri Crescent, The Hill”, referenced as 15/047 and dated 10/4/15, inclusive;
- Preliminary Architectural Drawings prepared by Marchese Partners International Pty Ltd, titled as “11-17 Mosbri Crescent, The Hill NSW 2300”, referenced as job 171114 and comprises of drawing from DA2.01 to DA2.11, revision P1 dated as 29/11/2018, water marked as **work in progress**.

This report presents the results of the preliminary site geotechnical investigation carried out to assess the geotechnical conditions of the subsurface materials at the proposed development site. This will be used to provide preliminary geotechnical design parameters and recommendations on the foundation type and other geotechnical advice relevant to construction of the proposed apartment buildings.

This report addresses to the following objectives outlined in our proposal:

- General description of site geology.
- Review of previous reports in the area.
- A description of soil conditions encountered including any fill.
- Identification of water table level where observed.
- Identification of suitable footing types & founding levels including:
  - Recommendations on bearing pressures for foundations, expected to be high level pad footings at the northern end and bored piers founded in rock at the southern end.
  - Advice on Pile design (including tension piles) and recommended geotechnical parameters and testing requirements in accordance with AS2159, including both allowable and ultimate shaft adhesion and end bearing.
- Parameters for retaining wall/shoring design (including both at rest and active parameters, cohesion values for clays and lateral bearing capacities).
- Advice on the construction of temporary and permanent batters.
- Reporting on site conditions, constraints to development and excavation conditions including the existence of any wet or poor subgrade conditions.
- Advice on techniques for establishing building platforms including treatment of wet and unsuitable areas.
- Advice on the ability to excavate subsoil materials (particularly rock) likely to be encountered during construction.
- Identification of "site sub-soil classification" for earthquake design as per AS1170.4-2007.
- Pavement design parameters.

To address the objectives above, our scope of work has included an investigation programme including boreholes, laboratory testing and analysis as described below.

2. Fieldwork

Coffey undertook a combined fieldwork set out for mine subsidence investigation, geotechnical investigation and environmental sampling. Fieldwork was carried out from 3 to 21 September 2018. For geotechnical parameters Coffey completed the following:

- Setting out borehole location based on dial before you dig plans and site access
- Drilling of five boreholes BH01, BH02, BH02a, BH03 and BH04, using a tracked Comacchio 450P drill rig. Note that BH02 was terminated due to service strike and re-located to BH02a location, as shown in the borehole location Drawing 1.
- BH01, BH02, BH02a, BH03 and BH04 were augured down to 4.5m, 4.0m, 0.25m, 3.4m and 4.7m below ground level, respectively with SPT's completed at 1.5m intervals. Drilling continued as rotary core drilling for pile design and mine subsidence investigation in BH01 and BH03 to the base of the Borehole Seam Workings to 102.1m depth. BH02a and BH04 continued as PCD drilling (not cored) to the base of the Borehole Seam Workings to 102.0m and 101.6m depth, respectively.
- Laboratory testing was carried out on samples retrieved during drilling and following tests were done:
  - 2 nos. four-day soaked California Bearing Ratio (CBR).
  - 3 nos. shrink/swell.

- 2 nos. Atterberg Limit.
- Point Load index tests at 2m centres.

Field work was carried out in the full-time presence of Coffey geotechnical engineers who produced field logs and nominated sampling of the boreholes.

Site location and the locations of the boreholes are shown in Drawing 1. The engineering logs and core photos for the boreholes are presented in Appendix A, together with explanatory Sheets defining the terms and symbols used. Results from laboratory testing are included in Appendix B.

3. Site Conditions

3.1. Surface Conditions

The site is an irregular shaped land with an approximate area of 1.2ha and consists of properties 11-17 Mosbri Crescent, Cooks Hill.

At the time of the investigation, a two / three storey commercial building was present within the site (NBN building), covering one third of the site area with a single basement level carpark. A couple of sheds, cooling tower and satellite dish were present within the rear portion of the property. A two level carpark was present towards the north and few parking bays at the back of the exiting NBN building. The remaining site area being covered in associated pavements, grassed area and several mature trees scattered along the site boundary. Vehicular access to site was via driveways from Mosbri Crescent.

The site is located within the Newcastle City Council area, adjacent to Mosbri Crescent carriageway, which is a minor road reserve within the local area. The site shares eastern boundary with Arcadia Park reserve located uphill. The site is bounded by the following properties, public roads and infrastructure:

- Kitchener Parade carriageway and road reserve to the north of the site
- Arcadia Park to the east of the site
- Two and three storey residential buildings and Mosbri Crescent to the north west and west of site boundary; and
- Single and double storey residential buildings to south and south west of the site

The site topography during the investigation slopes was generally gently to moderately sloping and has an angle of approximately 10° towards the south west to west.

3.2. Ground model

Based on the 1:100,000 scale Newcastle Coalfield Geology map, the site is underlain by rocks and soils derived from the late Permian aged Lambton Subgroup of the Newcastle Coal Measures comprising sandstone, siltstone, claystone, coal and tuff. This corresponds to site observations with high plasticity clay soils underlain by sandstone.

At the locations of the ground investigation results, the site is overlayed by fill material to a depths of between 0.25m and 2.8m. This is underlain by residual soils grading into extremely weathered material comprising clay materials to a depth of 4.7m. It is noted the boreholes were carried out in accessible areas only which comprise the current carpark or paved areas. Further drilling will be required at later stage to confirm the preliminary ground model.

The borehole location plan is provided in Drawing 1. All borehole logs from the site investigation are provided in Appendix A. The interpreted geotechnical units encountered at the site are shown in Table 1 with the distribution of the above units shown in Table 2.

Table 1: Summary of generalised ground model

Unit	Material / Origin	Description
1a	Fill	WEARING COARSE: bitumen sprayseal/s, up to 20mm thick varying within the site
1b	Fill	Sandy CLAY: low to medium plasticity, grey, dark brown, fine grained sand, with fine angular to sub-angular gravel Sandy GRAVEL: fine to coarse grained, sub-angular to angular, grey, with fine grained sand Clayey SAND: fine to coarse grained, brown and red Sandy CLAY: low to medium plasticity, dark brown, dark grey, mottled orange, fine grained sand, with fine, sub-angular to sub-rounded gravel and glass pieces
2a	Residual Soil	Sandy CLAY: low to medium plasticity, dark brown and dark grey, mottled red, fine to coarse grained sand CLAY: low to medium plasticity, grey to pale grey, orange laminations, mottled orange, red and brown, with fine grained sand and gravel Gravelly CLAY: low to medium plasticity, pale grey and grey, fine grained, rounded to sub-rounded gravel, trace of fine to coarse grained sand
2b	Extremely weathered material to highly weathered material	Sandy CLAY: low plasticity, orange, mottled pale brown, fine grained sand SANDSTONE: fine grained, pale grey and orange
3a	Moderately to slightly weathered rock	SANDSTONE: fine to medium grained, brown/orange and grey, with siltstone bands and black carbonaceous laminations, distinctly to slightly weathered, low to medium strength
3b	Coal Seam	COAL: black, crushed seams, extremely weathered to highly weathered, very low to low strength, cleated
3c	Slightly weathered to fresh rock	SANDSTONE: fine to medium grained, grey to brown, with black carbonaceous veneer, moderately to slightly weathered, low to medium strength
3d	Moderately to slightly weathered rock	SILTSTONE: grey to dark grey, with some sandstone bands, slightly weathered to fresh, low to medium strength
3e	Coal Seam	COAL: black, crushed seams, extremely weathered to highly weathered, very low to low strength, cleated
3f	Moderately to slightly weathered rock	SILTSTONE: grey to dark grey, with some sandstone bands, slightly weathered to fresh, low to medium strength
3g	Slightly weathered to fresh rock	SANDSTONE: fine to medium grained, grey to brown, with black carbonaceous veneer, moderately to slightly weathered, low to medium strength

Table 2: Distribution of geological units

Borehole ID	Depth to base of inferred geotechnical unit (m)										
	Unit 1a	Unit 1b	Unit 2a	Unit 2b	Unit 3a	Unit 3b	Unit 3c	Unit 3d	Unit 3e	Unit 3f	Unit 3g
BH01	0.05	0.40	4.20	4.50	13.65	NE	20.12	25.05	29.70	33.30	>40.00
BH02	0.03	1.7	3.6	4.04	NE						
BH02A	0.05	0.25	NE	NE	NC						
BH03	0.03	0.40	1.80	3.40	17.20	18.46	25.95	27.35	29.20	31.70	>40.00
BH04	0.02	2.80	4.60	4.70	NC						
Notes NE - Not encountered NC – Not cored											

3.3. Groundwater

Groundwater inflows were not encountered within soil profile during the site investigation. The stationary water levels after encountering the mine workings was approximately 3m AHD. Following drilling and as a part of the mine subsidence investigation, on 4 September 2018, a CCTV camera was used to observe conditions in the borehole BH01. Some water was observed flowing into the boreholes from 12m BGL (approximately 19m AHD) although the source could not be positively identified. Similar water was observed in BH03 on the 13 September 2018 from approximately 20m BGL 13m AHD. No such water was observed in BH04 on the 14 September 2018.

4. Laboratory testing

Samples obtained during the investigation were returned to Coffey's Newcastle laboratory for temporary storage and NATA accredited testing. Laboratory testing carried out is outlined in Section 2 Fieldwork.

The test results are presented in Appendix B and summarised in the following tables..

Table 3: Shrink swell test results

Hole ID	Depth (m)	Field Moisture Content (%)	Swell (%)	Saturated Moisture Content (%)	Shrinkage (%)	Iss (%)
BH02	0.5 – 0.8	19.8	-0.7	23.4	4.6	2.5
BH02	1.5 – 1.7	12.0	-0.7	15.3	0.9	0.5
BH04	2.0 – 2.3	20.2	-0.9	24.5	4.9	2.7

Table 4: CBR and standard maximum dry density test results

Borehole	Depth (m)	Field Moisture Content (%)	Optimum Moisture Content (%)	SMDD (t/m3)	CBR (1)
BH02	0.5 – 1.0	27.0	18.7	1.69	3.5
BH03	0.5 – 1.0	23.2	19.1	1.67	1.0
Notes (1): 4-day soak and 4.5kg surcharge					

Table 5: Atterberg limits test results

Borehole	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH02	1.4 – 1.5	38	14	24
BH04	1.5 – 2.0	19	14	5

5. Discussion

5.1. General

The proposed multi-building development will cover majority of the site area. Significant excavations will be required for basement levels construction. Drilling data indicate deep uncontrolled fill (refer to Section 3.2) is present at the south eastern corner of the NBN building (rear). Boreholes were drilled only within the footprint of proposed Building A and C due to access limitations and the primary focus of the investigation being for the mines. Additional deposits of uncontrolled fill are likely, and consideration should be given to further site investigation following the demolition works of the exiting building and associated structures for complete understanding of the geotechnical ground model. In the absence of an engineer's certification, all fill on the site is considered to be 'uncontrolled' and not suitable for support of structures or pavement.

5.2. Earthworks

5.2.1. Site preparation

General site preparation for the proposed development will require removal or relocation of services etc., and removal of vegetation across the footprint of the development. Following this all fill/topsoil, root affected materials and any obvious deleterious material should be removed and suitably disposed of or used for landscaping purposes only.

Given the cohesive nature of the subgrade materials, the site may become un-trafficable when subject to excessive moisture where minimal cut is proposed. Measures to protect the subgrade from ponding water should be considered. Such measures may include maintenance of suitable cross-falls to reduce the potential for water to pond and the provision of a working platform comprising of suitable crushed rock or concrete. The required thickness will depend on the plant required onsite.

Where deep basements are proposed with depths of cut exceeding 4m, the subgrade is expected to be generally sandstone reducing such issues.

5.2.2. Fill placement

Based on the preliminary drawings referenced in Section 1, minor fill may be required in the middle of the site between footprint of proposed Building B, C and the 2 storey townhouses. General guideline for fill placement is provided below:

- Prior to placement of any fill, the proposed fill area should be stripped to remove all vegetation, topsoil, existing fill or other potentially deleterious material. Based on site observations allowance should be made to strip a minimum of 0.25m to 2.8m or to the base of Unit 1a (potentially greater than 2.8m depth at places that could not be reached due to access issues).

The area to receive fill should be proof rolled to identify any loose or yielding areas. Any yielding areas should be excavated and replaced with controlled fill.

- All fill beneath structures should be compacted in layers not exceeding 300mm loose thickness to a minimum density ratio of 98% Standard Compaction within ± 2% of Optimum Moisture Content (OMC).
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion.
- Any fill placed over subgrade steeper than approximately 8H:1V should be benched into the subgrade in level lifts.

Earthworks should be planned, carried out and documented in accordance with the recommendations outlined in AS3798-2007 '*Guidelines for Earthworks for Commercial and Residential Developments'* and in accordance with Newcastle City Council Guidelines where applicable. Level 1 earthworks observation and testing is recommended for any controlled fill required to support structures, pavement or infrastructure and for all hillside earthworks.

5.2.3. Groundwater

Groundwater strikes were not recorded within the likely depth of excavation required for basements. It should be noted that seepage or groundwater inflows confined to specific rock defects may be encountered in basement excavations. Groundwater levels can fluctuate seasonally, and perched or elevated groundwater may be present following rain events. Minor groundwater management may be required during construction, but heavy dewatering in not anticipated to be necessary.

5.2.4. Excavation stability

Temporary excavations above the water table up to 2m high into natural clay can be expected to stand for short periods with vertical cuts, however workers on foot should not approach any vertical cut higher than 1.4m.

Based on the preliminary drawings, excavation is required of approximately 8.5m to 9.5m below existing ground level (RL 28.10m AHD and RL 29.60m AHD) for the Building A, B and C combined basement levels. Approximately 4.5m below ground level (basement RL 25.40m AHD to RL 27.40m AHD) will be required for the two storey townhouses. Temporary shoring may be designed based on retaining wall parameters presented Table 7 (Section 5.4 below).

All other temporary excavations should be cut at 1:1 or flatter. Steeper cuttings may be permissible with specific geotechnical advice, otherwise shoring will be required to accommodate construction. Shoring should be designed specific to conditions of the excavation and in consideration to project needs.

5.2.5. Dilapidation survey

For all excavations that are deeper than 1m at or near the site boundary, a dilapidation survey of the adjacent properties is recommended prior to excavation.

5.2.6. Excavatability

Significant excavation will be required for multi storey building combine basement. Typically, excavation will be 8.5m to 9.5m below ground level extending to RL 28.1m AHD and is therefore anticipated to be within the Unit 3a, sandstone rock with a low to medium strength (point loads I_{s50} less than 1MPa). The second smaller basement level at RL 25.4m AHD to RL 27.4m AHD follows the existing surface resulting in a shallower excavation up to 4.5m below ground level.

Based on our investigation, excavation within fill underlain by residual soils will be possible using conventional earthmoving equipment such as tracked loaders and hydraulic excavators. Based on the Chart by Pettifer & Frookes 1994), the rock is classified as easy ripping, and should be achievable with a D6 to D7 or equivalent dozer or a 30t excavator with a rock pick. Although not encountered in

our boreholes, concretionary zones may be present within the sandstone that require heavy ripping and possible breakers to achieve excavation. Where zero lot line excavation is required, rock sawing or milling may be required to achieve the required line and grade.

5.2.7. Reuse of material

Due to the proposed excavation onsite, a significant amount of material is expected to be generated.

Unit 1a and 1b comprises of material described as fill. Unit 1a material is unlikely to be suitable for reuse. Unit 1b fill may be used for landscaping purposes, and only after being checked and assessed for any deleterious or hazardous materials that may be embedded in it. Pieces of broken glass were found in fill material within BH04, indicating this material may have hazardous content.

Unit 2a and 2b typically comprises sandy clay with gravel, clay to sandy clay. Although the fines component of the material comprised low to medium plasticity clay, due to the proportion of sands and gravels the material has a low to medium shrink swell potential (Is value of 2.7). As such this material is likely to be suitable for reuse onsite as engineered fill (except for drainage zones at the back of retaining walls).

The excavations will also generate Unit 3a moderately weathered to slightly weathered, low to medium strength rock material. The material generated by excavation of sandstone rock can be re-used for engineered fill and drainage zones at the back of retaining walls.

It is not anticipated that excavations will not generate any Unit 3b, c, d, e, f and g rock material.

5.3. Foundation

All footing elements should be placed beneath any uncontrolled fill.

The footings of a single structure should be founded within the same strata unless the structure can be designed with articulation to accommodate potential differential ground response to loading. Further investigation will be required to assess ground condition for all proposed buildings.

5.3.1. High level footings

Limited borehole data is available within the footprint of the proposed two storey townhouses and Building B location. Based on the subsurface profiles encountered, it is anticipated that materials exposed near proposed basement level for buildings include:

- The front Mosbri Crescent townhouse has a current surface of 28m to 32m AHD with a proposed floor level of 25.4m to 27.4m AHD. As such the foundations will be 3m to 5m below current surface level and are expected to be within extremely weathered material (Unit 2b). As such it is preliminarily assessed the soil will include hard or better clays with an allowable bearing capacity of 250kPa.
- Building A has a current surface of 31m up to 37m AHD with a proposed floor level of 28.1m resulting in excavations between 3.3m to 9m. As such the foundations will be within slightly weathered material (Unit 3a). As such it is preliminarily assessed the front (south or shallowest cut) will be within (Class IV or better) rock and may be proportioned for an allowable ultimate bearing pressure of 500kPa (refer to Pells et al 1998). Similarly, at the rear of the building (northern or deepest cut) the rock strength is expected to increase to medium strength. Foundations within (Class III or better) rock and may be proportioned for an allowable ultimate bearing pressure of 1000kPa, however as discussed previously will require verification.
- Similar to Building A, Building B has a current surface of 30m up to 38m AHD with a floor level of 28.7m. The front two storey townhouses for this building are likely to be founded in Unit 2b allowable ultimate bearing capacity of 250kPa. The middle portion will likely be founded within Class IV sandstone allowable ultimate bearing pressure of 500kPa while the rear (deepest cut on the eastern side) assuming (Class III or better) rock and may be proportioned for an allowable ultimate bearing pressure of 1000kPa.

- Building C currently has a surface from 32m up to 38m AHD with a floor level of 29.6m. The front two storey townhouses for this building are likely to be founded in Unit 2b allowable ultimate bearing capacity of 250kPa. The remainder will likely be founded within Class IV sandstone allowable ultimate bearing pressure of 500kPa.

However, these values will need to be verified by detailed coring spread across the site.

5.3.2. Deep footings

Deep pile footings may be required at places with deep fill/soil profile if encountered within footprint of the proposed development, or where basement excavations span the transition between material type. Additional investigation will be required to confirm the founding conditions for the proposed buildings.

Piles socketed in a minimum of 0.3m into the geological Unit 3a (slightly weathered), may be designed for geotechnical strength parameters in accordance with the guidelines presented in Australian Standard AS2159-2009, Piling Design and Installation, as shown in Table 6. The final end bearing elevation will need to be a minimum of 3 pile diameters above the Upper Dudley Coal Seam split (Unit 3b). The preliminary ultimate capacities for deep footings are given in Table 6.

Table 6: Preliminary ultimate deep foundation design parameters

Unit	Origin	Material	Ultimate End Bearing Pressure (MPa)(1)	Serviceability End Bearing Pressure (MPa)(2)	Ultimate Shaft Adhesion (kPa)
2a	Residual soil	Very Stiff clay or better	N/A	N/A	45
2b	Extremely weathered rock	Hard clay or better	2	0.7	65
3a	Moderately to slightly weathered sandstone rock	Class IV or better	4	2.5	100
Unit 3a Depths > 6m	Slightly weathered sandstone rock	Class III or better	10	3.5	300
Notes: (1) Ultimate values occur at large settlements (>5% of minimum footing dimensions). (2) Serviceability cause settlement of less than 1% of minimum footing dimensions).					

A geotechnical reduction factor ϕ_g of 0.45 should be applied to the above values for the geotechnical design. This reduction factor may be increased with more site investigation and site-specific pile load testing.

All footings should be free of loose or softened material and free of water prior to the placement of concrete. Concrete should be placed as soon as possible after the drilling/excavation to prevent softening of the footing base or pier walls. A suitably experienced geotechnical consultant should observe footing drilling / excavation to assess that the recommended founding material has been reached and to confirm that conditions encountered are consistent with those described in this report.

5.3.3. Earthquake design

Based on the geotechnical investigation results and the observed subsurface profile, an earthquake subsoil classification of "**Class C_e – Shallow Soil**" and hazard design factor Z is 0.12 for as per AS 1170.4 may be adopted for this site in its existing and proposed condition.

5.4. Retaining wall design

The soil parameters shown in Table 7 below can be used in the short and long-term design of the retaining walls.

It is noted that retaining walls constructed as part of the building walls will need to be designed for at rest (k_0) earth pressures due to their fixity. This is also the case for walls within close proximity of structures sensitive to movements.

Engineered retaining walls may be designed using the guidelines presented below. The design must include an assessment of global stability of the walls and surrounding soils. This is particularly the case for the combined basement levels excavation for Building A and B where the excavation will be within the zone of influence of the Kitchener Parade retaining wall.

Drainage behind the wall should, as a minimum, comprise a geo-composite drain or geotextile wrapped gravel drain at the back of the wall that drains to a geotextile wrapped subsoil drain along the wall toe. The toe drain should discharge to the site storm water system to provide long term drainage behind retaining walls.

Table 7: Retaining wall parameters

Soil Type	Residual Soil (Unit 2a)	Extremely weathered rock (Unit 2b)	Compacted Granular Backfill behind the wall
Short term shear strength (Su kPa)	75	200	NA
Long term (drained) friction angle (ϕ' °)	26	28	33
Long term (drained) effective cohesion (c′ kPa)	5	7	0
Unit Weight (γ kN/m^3)	18	20	18
Coefficient of Lateral Earth Pressure at rest k_0	1.8	1.8	0.45
Coefficient of Active Earth pressure k_a	0.40	0.37	0.30
Clay coefficient of Active Earth pressure k_{ac}	1.25	1.2	N/A
Coefficient of Passive Earth pressure k_p	1.7	1.8	2.0

5.5. Pavement design parameters

From the laboratory testing the clay subgrade has a Californian Bearing Ratio (CBR) of 1% to 3.5%. Where sandstone is exposed (i.e. excavations greater than 4m) this may be increased to CBR 10% subject to further investigation.

6. Limitations

Guidance on the uses and limitations of this report is presented in the attached sheet, 'Important Information about your Coffey Report', which should be read in conjunction with this report.

Signature:	
Full name:	Simon Baker
Title:	Senior Geotechnical Engineer
Date:	14 January 2019

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

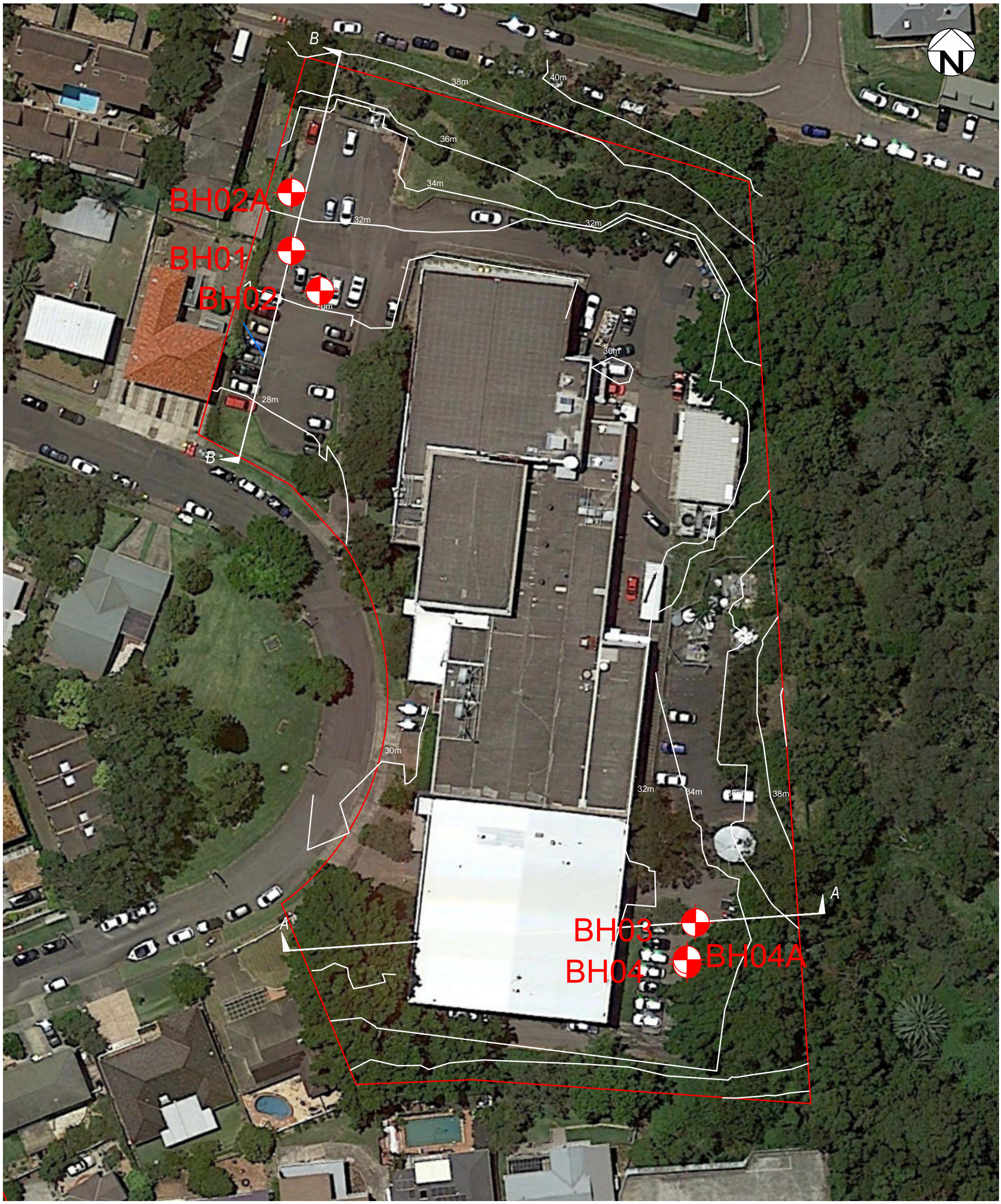
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Drawings



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

APPROXIMATE BOREHOLE LOCATION

SECTION LINE

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2014

5 0 5 10 15 20

Scale (metres) 1:600

drawn	SJB
approved	JD
date	30/10/2018
scale	AS SHOWN
original size	A3

coffey

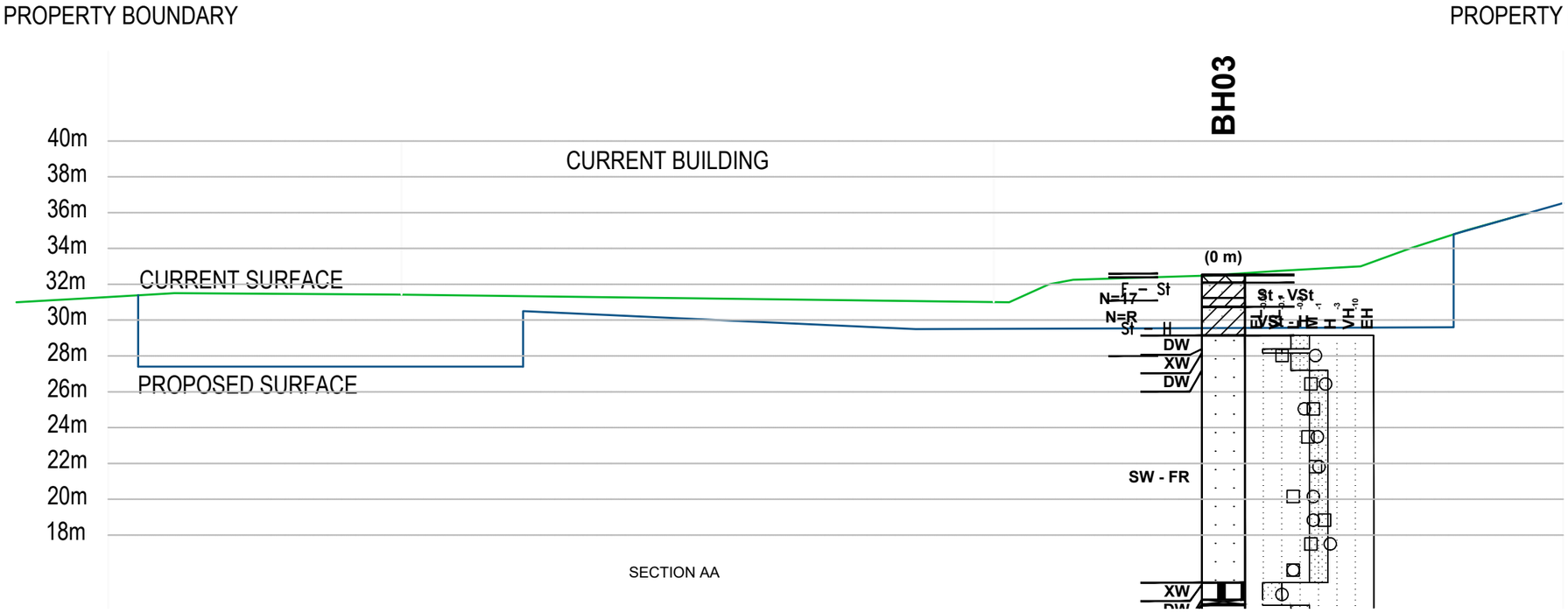
client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE 11-17 MOSBRI CRESCENT THE HILL
PRELIMINARY GEOTECHNICAL INVESTIGATION

title: PROPOSED BOREHOLE LOCATION PLAN

project no: 754-NTLGE220504 | drawing no: DRAWING 1 | rev: A

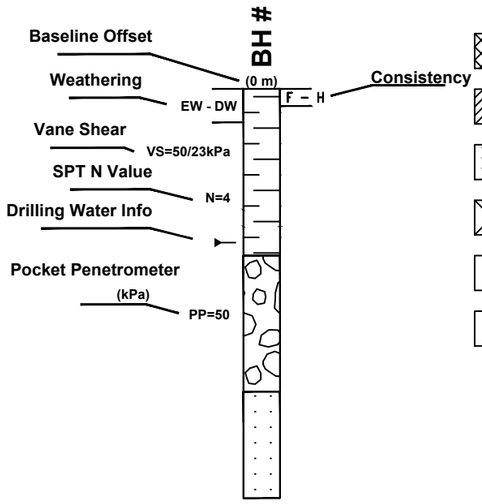
PLOT DATE: 30/10/2018 5:39:25 PM DWG FILE: F:\GEOTECH\NICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\7754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN SJB_RECOVER.GEOT.DWG



LEGEND

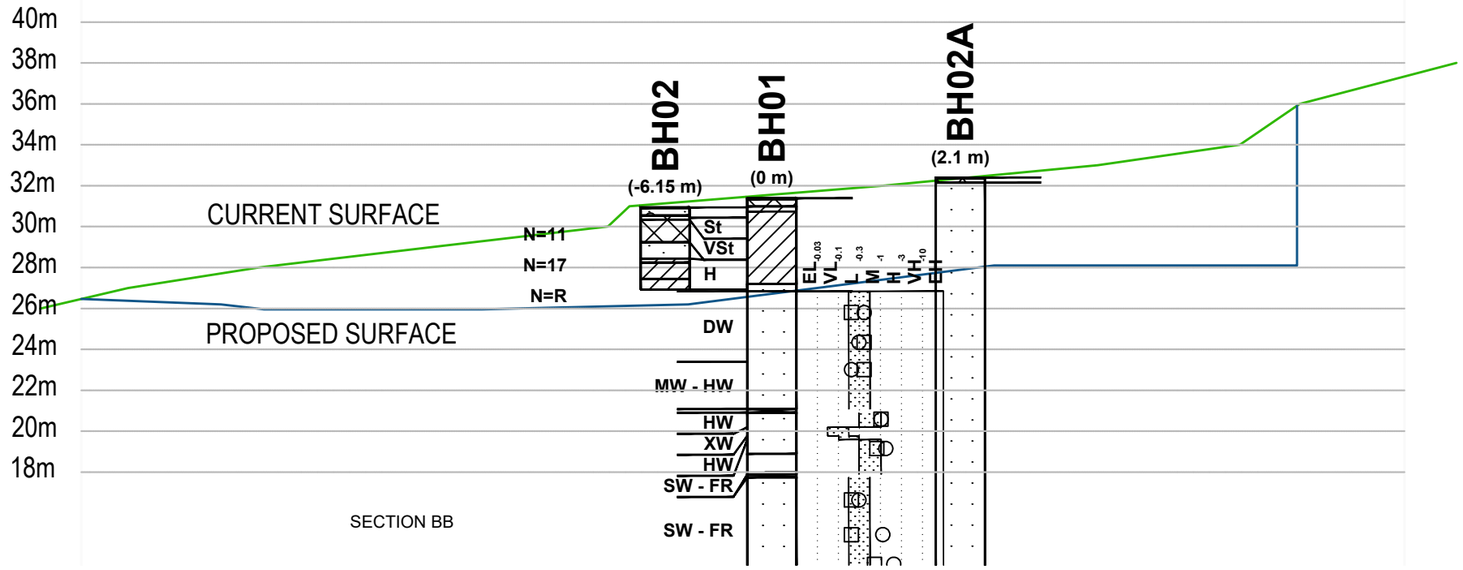
- CURRENT SURFACE
- PROPOSED BASEMENT FLOOR LEVEL

BOREHOLE LEGEND



MATERIAL GRAPHIC

FILL, GRAVEL, CLAY, ASPHALT, SANDSTONE, SANDY GRAVEL, NO CORE, SANDY CLAY, SILTSTONE, CLAYEY SAND, COAL, GRAVELLY CLAY



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

5 0 5 10 15

Scale (metres) 1:300

drawn	SJB
approved	JD
date	30/10/2018
scale	AS SHOWN
original size	A3

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client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE 11-17 MOSBRI CRESCENT THE HILL
PRELIMINARY GEOTECHNICAL INVESTIGATION

title: SECTION AA AND BB

project no: 754-NTLGE220504 | drawing no: DRAWING 2 | rev: A

PLOT DATE: 30/10/2018 5:39:34 PM DWG FILE: F:\GEOTECH\NICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN SJB_RECOVER GEOT.DWG

Appendix A – Borehole Logs

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Engineering Log - Borehole

Borehole ID.	**BH01**
sheet:	1 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) | surface elevation: 31.39 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E	31			CL-CI	**FILL: BITUMEN**: black, 50mm thick, fine to coarse gravel.	M			**FILL- WEARING COURSE**
									<Wp			**FILL**
			E				CH	**FILL: Sandy CLAY**: low to medium plasticity, grey, with fine grained sand.	>Wp			
								CLAY: high plasticity, grey and pale grey, with orange lamination.				**RESIDUAL SOIL**
			E		1.0							
			D + E	30			CL-CI	**CLAY**: low to medium plasticity, pale brown and grey, orange laminations, with fine sand, trace of fine gravel.	<Wp			
			E		2.0			2.0 m: becoming more pale grey and pale brown				
			E	29								
			E		3.0							
			B	28								
			E		4.0		SP	**SANDSTONE**: fine grained, orange, extremely weathered, very low to low strength.	M			**HIGHLY WEATHERED MATERIAL**
				27				Borehole BH01 continued as cored hole				
					5.0							
				26								
					6.0							
				25								
					7.0							
				24								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	2 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) | surface elevation: 31.39 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		31	1.0		started coring at 4.55m						
		30	2.0								
		29	3.0								
		28	4.0								
HQ		27	5.0		**SANDSTONE**: fine to medium grained, brown/orange and grey, with sitlstone bands and black carbonaceous laminations.	DW		a=0.40 d=0.20	82%		PT, 0 - 5°, PL, RO, CN JT, 30°, PL, RO, CN JT, 75 - 90°, CU, RO, SN PT, 0°, PL, VR, SN PT, 20°, PL, RO, SN Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
		26	6.0								
		25	7.0					a=0.30 d=0.40			
		24									

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	3 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		23	9.0		**SANDSTONE**: fine to medium grained, brown/orange and grey, with sitlstone bands and black carbonaceous laminations. *(continued)* 8.00 m: becoming grey 8.55 m: 250mm of carbonaceous laminations	MW - HW		a=0.20 d=0.40	82%		PT, 5°, PL, RO, SN
		22									
			10.0						71%		JT, 50°, PL, RO, SN JT, 50°, PL, RO, SN
		21			**NO CORE:** 0.18 m						
					SANDSTONE: fine to medium grained, brown and grey, with sitlstone bands and black carbonaceous laminations.	HW		a=1.00 d=1.00			JT, 70°, PL, RO, SN JT, 40°, PL, RO, SN JT, 30°, PL, RO, SN
			11.0								PT, 0°, PL, RO, SN
		20				XW			0%		
						HW					
			12.0			SW - FR					
		19			**SILTSTONE**: grey to dark grey, with sandstone bands and black carbonaceous laminations.			a=1.30 d=0.80			CS, IR, RO, SN JT, 70°, PL, RO, SN
			13.0								JT, 35°, PL, RO, SN
		18							82%		
					NO CORE: 0.15 m						
			14.0		**SANDSTONE**: fine grained, grey, with sitlstone bands and black carbonaceous laminations.	SW - FR					
		17			14.57 m: 70mm sandstone band			a=0.30 d=0.20			SM, 0°, PL, RO, CO
			15.0		15.00 m: 150mm sandstone band						
		16			15.30 m: 150mm sandstone band with carbonaceous laminations				97%		

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Borehole

Borehole ID.	**BH02**
sheet:	1 of 1
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**10 Sep 2018**
principal:	
date completed:	**10 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,624.50; N: 6,355,677.60 (MGA94) | surface elevation: 30.94 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T		Not Observed	E					**FILL: BITUMEN**: Black, fine to coarse subangular gravel.				**FILL- WEARING COURSE**
			E				CL	**FILL: Sandy GRAVEL**: fine to coarse grained, brown, with some cobbles 63mm to 80mm.	M	St		**FILL- PAVEMENT**
			E	30			CL	**FILL: Sandy CLAY**: low to medium plasticity, dark grey, grey and brown, fine to medium sand, some surounded sized gravel.	>Wp	VSt		**FILL**
			SPT 3, 3, 8 N*=11		1.0			**FILL: CLAY**: medium plasticity, grey and pale grey, with orange.				
			E	29			SC	**CLAYEY SAND**: fine to coarse grained, pale brown and pale grey.	M			**RESIDUAL SOIL**
			SPT 6, 8, 9 N*=17	28	2.0		CL	**Sandy CLAY**: medium plasticity, grey, fine to medium grained sand.	~Wp	H		
					3.0		CL	**CLAY**: medium plasticity, orange mottled pale grey.	<Wp			**EXTREMELY WEATHERED MATERIAL**
			SPT 15/10mm HB N*=R	27	4.0			Borehole BH02 terminated at 4.01 m Safety reasons				
				26	5.0							
				25	6.0							
				24	7.0							
				23								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance
- ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	1 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***20 Sep 2018***
principal:	
date completed:	***21 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD RR N		Not Observed	E E	32 31 30 29 28 27 26 25	1.0 2.0 3.0 4.0 5.0 6.0 7.0			**FILL: BITUMEN PAVEMENT**: black, 50mm.	M			**FILL- WEARING COURSE**
								FILL: Gravelly SAND: fine to coarse grained, brown and pale grey, with angular to sub-angular gravel.				**FILL- PAVEMENT**
								SANDSTONE.				**HIGHLY WEATHERED BECOMING MODERATELY WEATHERED MATERIAL**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	**BH02A**
sheet:	2 of 13
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**20 Sep 2018**
principal:	
date completed:	**21 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		24	9.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**
				23								
				22	10.0							
				21	11.0							
				20	12.0							
				19	13.0							
				18	14.0							
				17	15.0							

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	**BH03**
sheet:	1 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) | surface elevation: 32.75 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E				GP	**FILL: BITUMEN**: black, 50mm.	M			**FILL- WEARING COURSE**
								FILL: Sandy GRAVEL: fine to coarse grained, grey, angular to sub-angular, fine grained sand.				**FILL- PAVEMENT**
			E	32			CI	**Sandy CLAY**: medium plasticity, mottled red and brown.	>Wp	St - VSt		**RESIDUAL SOIL**
			SPT 5, 7, 10 N=17		1.0		CI	**CLAY**: medium plasticity, pale grey and red mottled orange.	>Wp			
			B	31			CL	**Sandy CLAY**: low plasticity, orange mottled pale brown, fine grained sand.	<Wp	VSt - H		**EXTREMELY WEATHERED ROCK**
			SPT 21, 30/90mm N=R	30	2.0							
					3.0							
N				29	4.0			Borehole BH03 continued as cored hole				
				28	5.0							
				27	6.0							
				26	7.0							
				25								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	2 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		32	1.0								
		31	2.0								
		30	3.0		started coring at 3.40m						
HQ		29	4.0		**SANDSTONE**: fine to medium grained, brown to pale brown, grey to dark grey, with siltstone bands.	DW					PT, 0°, PL, RO, CN
						XW					PT, 40°, IR, RO, SN PT, 10°, IR, RO, SN Drilling Break
		28	5.0			DW		a=0.80 d=0.10	72%		PT, 0°, PL, RO, VN JT, 70°, PL, RO, SN Drilling Break
		27	6.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations.	SW - FR		a=1.50 d=0.60			PT, 5 - 10°, ST, SN Drilling Break Drilling Break
		26	7.0					a=0.40 d=0.70	97%		PT, 0°, PL, VR, CN Drilling Break PT, 5°, CU, RO, SN PT, 5°, CU, RO, CN Drilling Break
		25									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	3 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ		24	9.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)* 8.10 m: 50mm siltstone band	SW - FR			97%		Drilling Break	Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described
		23			9.15 m: 50mm carbonaceous laminations			a=0.90 d=0.50			Drilling Break	
		22	10.0					a=1.00 d=0.80	100%			
		21	11.0		11.60 m: 170mm carbonaceous laminations							
		20	12.0		12.12 m: 200mm siltstone band			a=0.70 d=0.20			PT, 0°, PL, VR, CO	
		19	13.0		13.25 m: 180mm siltstone band			a=0.70 d=1.40	87%			
		18	14.0								JT, 40°, IR, RO, SN JT, 40°, PL, RO, SN	
		17	15.0					a=2.00 d=0.60	85%		JT, 70°, PL, RO, SN JT, 70°, ST, RO, SN	

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Borehole

Borehole ID.	**BH04**
sheet:	1 of 13
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**12 Sep 2018**
principal:	
date completed:	**14 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E				GW	**FILL: BITUMEN PAVEMENT**: black, 20mm.				**FILL- WEARING COURSE**
							SW	**FILL: Sandy GRAVEL**: fine to coarse grained, sub-angular to angular, grey, with fine grained sand.	M <Wp	F - St		**FILL- PAVEMENT**
			E	32			CL	**FILL: CLAYEY SAND**: fine to coarse grained, brown and red.				**FILL - UNCONTROLLED**
					1.0			**FILL: Sandy CLAY**: low plasticity, brown, dark brown, pale grey, fine to coarse grained sand, with fine grained grained angular to sub-angular gravel.				
			E				CL	**FILL: Sandy CLAY**: low plasticity, dark brown, mottled orange, fine grained sand, with fine grained sub-angular to sub-rounded gravel and glass pieces.		St - H		
			SPT 5, 5, 5 N=10	31								
			E		2.0							
			SPT 3, 4, 5 N=9	30								
			B		3.0		CL-CI	**Sandy CLAY**: low to medium plasticity, dark brown and dark grey, fine to coarse grained sand.	~Wp			**RESIDUAL SOIL**
				29			CL-CI	**CLAY**: low to medium plasticity, mottled orange and brown, with fine rounded to sub-rounded gravel.				
					4.0		CL-CI	**Sandy CLAY**: low to medium plasticity, dark grey, with medium to course grained sand, with fine angular to sub-angular gravel.	>Wp			**EXTREMELY WEATHERED MATERIAL**
N			SPT 7, 25/30mm N=R	28			CL-CI	**Gravelly CLAY**: fine to medium grained, low to medium plasticity, pale grey and grey, with rounded to sub-rounded gravel, trace of fine to coarse grained sand.				**HIGHLY WEATHERED BECOMING MODERATELY WEATHERED MATERIAL**
					5.0			**SANDSTONE**: fine grained, pale grey and orange.				
				27				**SANDSTONE**.				
RR					6.0							
				26								
					7.0							
				25								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	**BH04**
sheet:	2 of 13
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**12 Sep 2018**
principal:	
date completed:	**14 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N				24 23 22 21 20 19 18 17	9.0 10.0 11.0 12.0 13.0 14.0 15.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04A***
sheet:	1 of 1
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***14 Sep 2018***
principal:	
date completed:	***14 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: Not Specified | surface elevation: 32.80 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: | hole diameter : 300 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T, N		Not Observed	E, E, E	32	1.0			**FILL: BITUMEN**: black, fine to coarse gravel.				**FILL- WEARING COURSE**
								FILL: Sandy GRAVEL: medium to coarse grained, grey, fine to coarse sized sand.				**FILL- PAVEMENT**
								FILL: Gravelly SAND: fine to coarse grained, brown, some pieces of fine to coarse subangular gravel, some pieces of brick, terracotta, steel, concrete and cobbles of sandstone and other crushed rock. 0.3 m: Steel bar				**FILL - UNCONTROLLED**
								FILL: CONCRETE BOULDER: 110mm thick.				
				31	2.0			**FILL: Gravelly SAND**: fine to coarse grained, brown, some pieces of fine to coarse subangular gravel, some pieces of brick, terracotta, steel, concrete and cobbles of sandstone and other crushed rock.				
				30	3.0			Borehole BH04A terminated at 1.0 m Refusal				
				29	4.0							
				28	5.0							
				27	6.0							
				26	7.0							
				25								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Appendix B – Laboratory Test Results

Newcastle Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
19 Warabrook Boulevard
Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

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California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08413
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

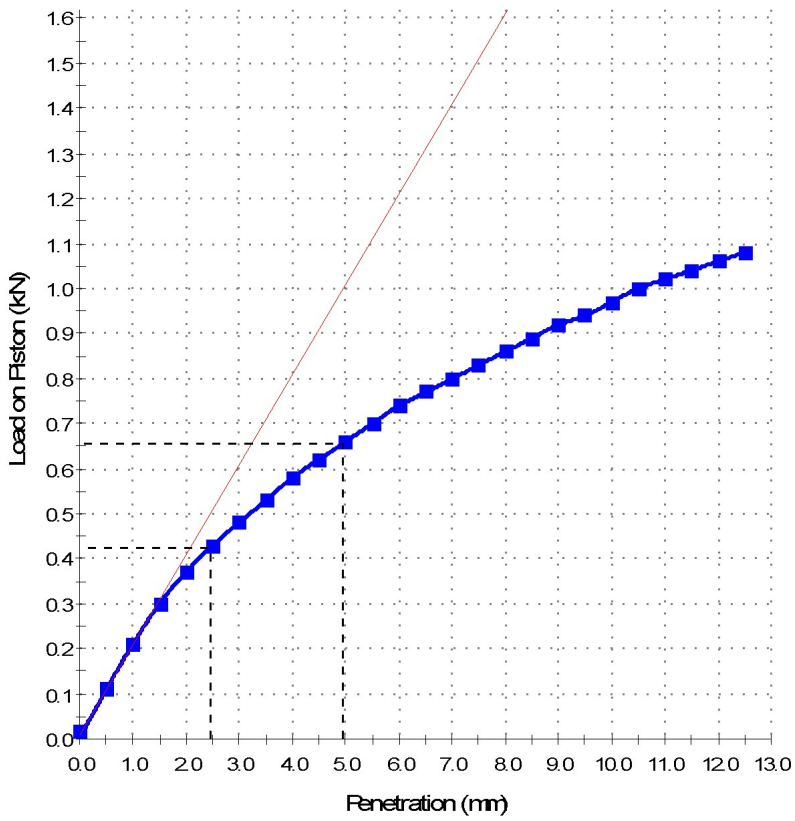
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 3/10/2018

Sample Details

Sample ID:	NEWC18S-08413	**Sampling Method:**	Submitted by client
Date Sampled:	24/09/2018	**Material:**	Existing Ground
Date Submitted:	25/09/2018	**Source:**	On-Site
Date Tested:	2/10/2018	**Specification:**	No Specification
Project Location:	Newcastle, NSW		
Sample Location:	BH02 - 0.5 - 1.0m		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 5.0mm (%):	**3.5**
Maximum Dry Density (t/m³):	1.70
Optimum Moisture Content (%):	18.7
Dry Density before Soaking (t/m³):	1.69
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	18.9
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.68
Density Ratio after Soaking (%):	99
Swell (%):	0.5
Moisture Content of Top 30mm (%):	22.2
Moisture Content of Remaining Depth (%):	20.1
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material (%):	0.0
—Moisture Content—	
Field Moisture Content (%):	27.0
Curing Time (Hrs):	23.0
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

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A TETRA TECH COMPANY

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08414
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

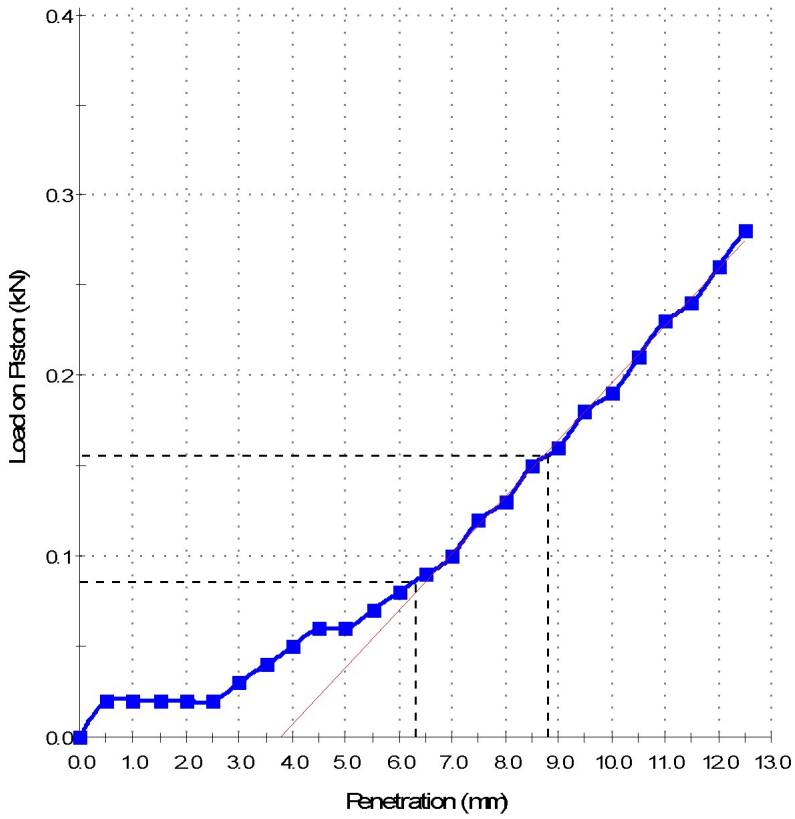
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 3/10/2018

Sample Details

Sample ID:	NEWC18S-08414	**Sampling Method:**	Submitted by client
Date Sampled:	24/09/2018	**Material:**	Existing Ground
Date Submitted:	25/09/2018	**Source:**	On-Site
Date Tested:	2/10/2018	**Specification:**	No Specification
Project Location:	Newcastle, NSW		
Sample Location:	BH03 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR At 5.0mm (%):	**1.0**
Maximum Dry Density (t/m³):	1.67
Optimum Moisture Content (%):	19.1
Dry Density before Soaking (t/m³):	1.67
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	18.9
Moisture Ratio before Soaking (%):	99
Dry Density after Soaking (t/m³):	1.59
Density Ratio after Soaking (%):	95
Swell (%):	5.0
Moisture Content of Top 30mm (%):	28.0
Moisture Content of Remaining Depth (%):	27.4
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material:	Excluded
Oversize Material (%):	2.6
—Moisture Content—	
Field Moisture Content (%):	23.2
Curing Time (Hrs):	23.2
Plasticity Level Method:	Visual

Comments

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Material Test Report

Report No: NEWC18S-08418-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

NATA
WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/10/2018

Sample Details

Sample ID:	NEWC18S-08418
Client Sample:	-
Date Sampled:	24/09/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Newcastle, NSW
Sample Location:	BH02 - 1.4 - 1.5m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	7.0	
Mould Length (mm)		254	
Liquid Limit (%)	AS 1289.3.1.1	38	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	24	
Date Tested		4/10/2018	

Comments

N/A

Newcastle Laboratory

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A TETRA TECH COMPANY

Material Test Report

Report No: NEWC18S-08419-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

NATA
WORLD RECOGNISED ACCREDITATION

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Approved Signatory: Chris Blackford
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/10/2018

Sample Details

Sample ID:	NEWC18S-08419
Client Sample:	-
Date Sampled:	24/09/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Newcastle, NSW
Sample Location:	BH04 - 1.5 - 2.0m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	2.0	
Mould Length (mm)		250	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	19	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	5	
Date Tested		5/10/2018	

Comments

N/A

Newcastle Laboratory

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Shrink Swell Index Report

Report No: SSI:NEWC18S-08415
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/10/2018

Sample Details

Sample ID:	NEWC18S-08415	**Sampling Method:**	Submitted by client
Date Sampled:	24/09/2018	**Material:**	Existing Ground
Date Submitted:	25/09/2018	**Source:**	On-Site
Date Tested:	2/10/2018		
Project Location:	Newcastle, NSW		
Sample Location:	BH02 - 0.5 - 0.8m		
Borehole Number:	BH02		
Borehole Depth (m):	0.5-0.8		

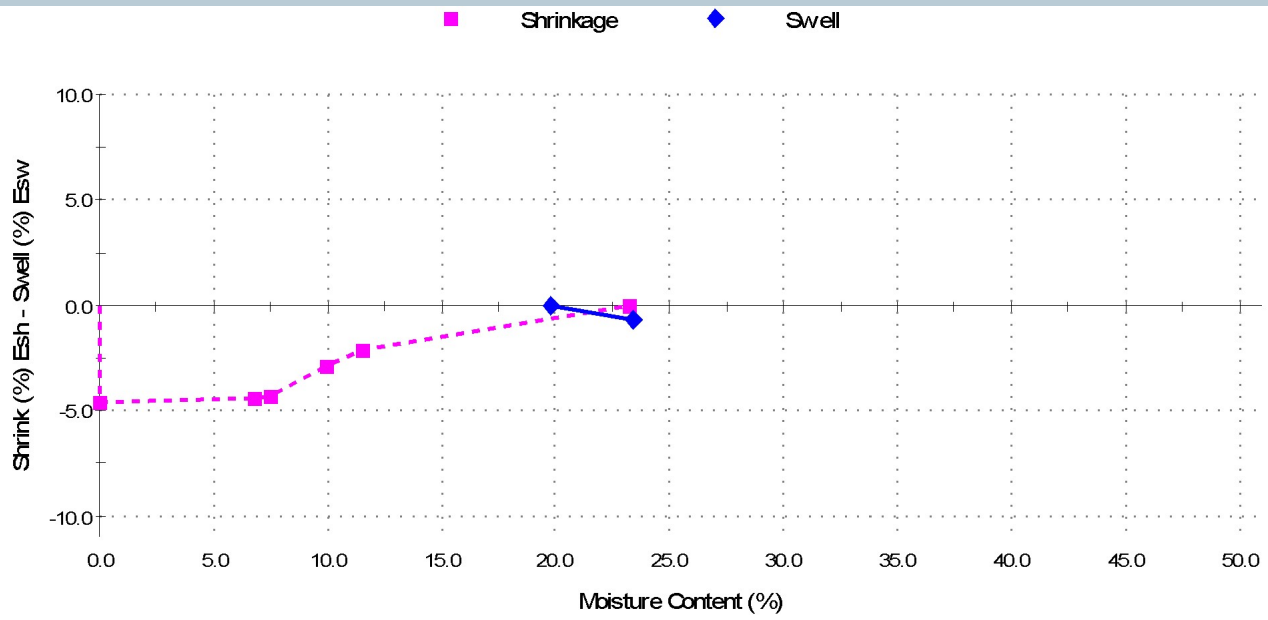
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.7
Moisture Content before (%):	19.8
Moisture Content after (%):	23.4
Est. Unc. Comp. Strength before (kPa):	180
Est. Unc. Comp. Strength after (kPa):	170

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	4.6
Shrinkage Moisture Content (%):	23.2
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 2.5

Comments

Clay, medium to high plasticity brown.

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Shrink Swell Index Report

Report No: SSI:NEWC18S-08416
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/10/2018

Sample Details

Sample ID:	NEWC18S-08416	**Sampling Method:**	Submitted by client
Date Sampled:	24/09/2018	**Material:**	Existing Ground
Date Submitted:	25/09/2018	**Source:**	On-Site
Date Tested:	2/10/2018		
Project Location:	Newcastle, NSW		
Sample Location:	BH04 - 2.0 - 2.3m		
Borehole Number:	BH04		
Borehole Depth (m):	2.0 - 2.3		

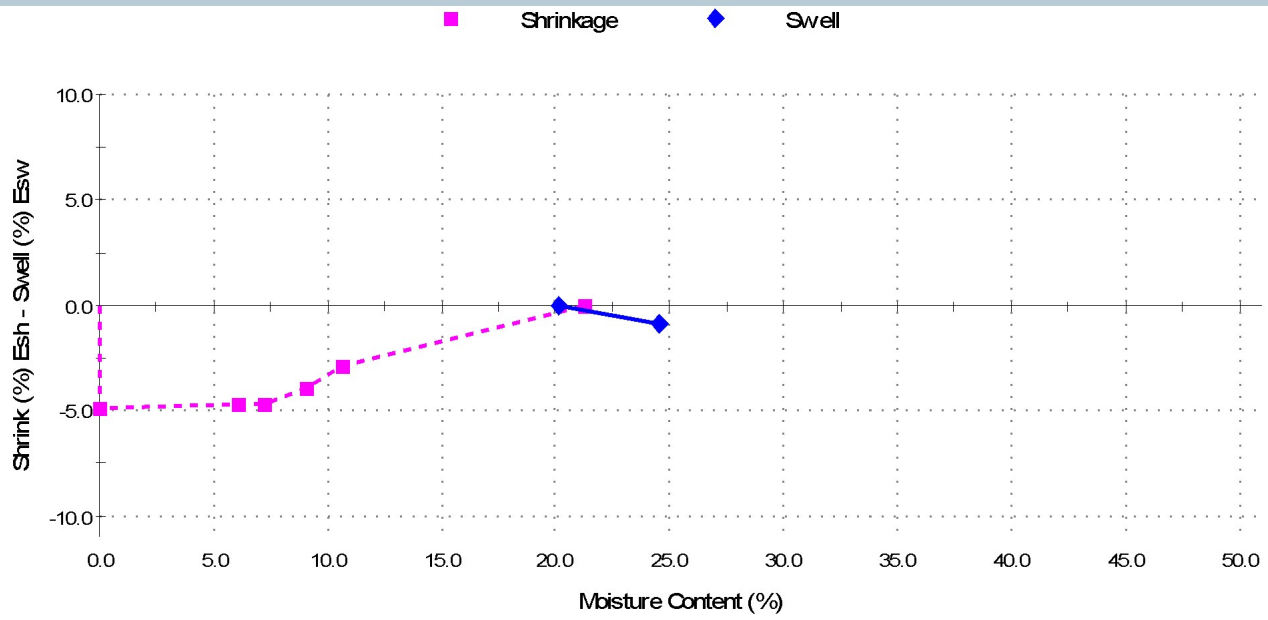
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.9
Moisture Content before (%):	20.2
Moisture Content after (%):	24.5
Est. Unc. Comp. Strength before (kPa):	120
Est. Unc. Comp. Strength after (kPa):	90

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	4.9
Shrinkage Moisture Content (%):	21.3
Est. inert material (%):	<5
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 2.7

Comments

Clay medium to high plasticity, brown.

Newcastle Laboratory

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Shrink Swell Index Report

Report No: SSI:NEWC18S-08417
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00587AA
Project Name:	754-NTLGE220504 - 754-11-17 MOSBRI CR COOKS HILL
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

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Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/10/2018

Sample Details

Sample ID:	NEWC18S-08417	**Sampling Method:**	Submitted by client
Date Sampled:	24/09/2018	**Material:**	Existing Ground
Date Submitted:	25/09/2018	**Source:**	On-Site
Date Tested:	2/10/2018		
Project Location:	Newcastle, NSW		
Sample Location:	BH02 - 1.5 - 1.7m		
Borehole Number:	BH02		
Borehole Depth (m):	1.5 - 1.7		

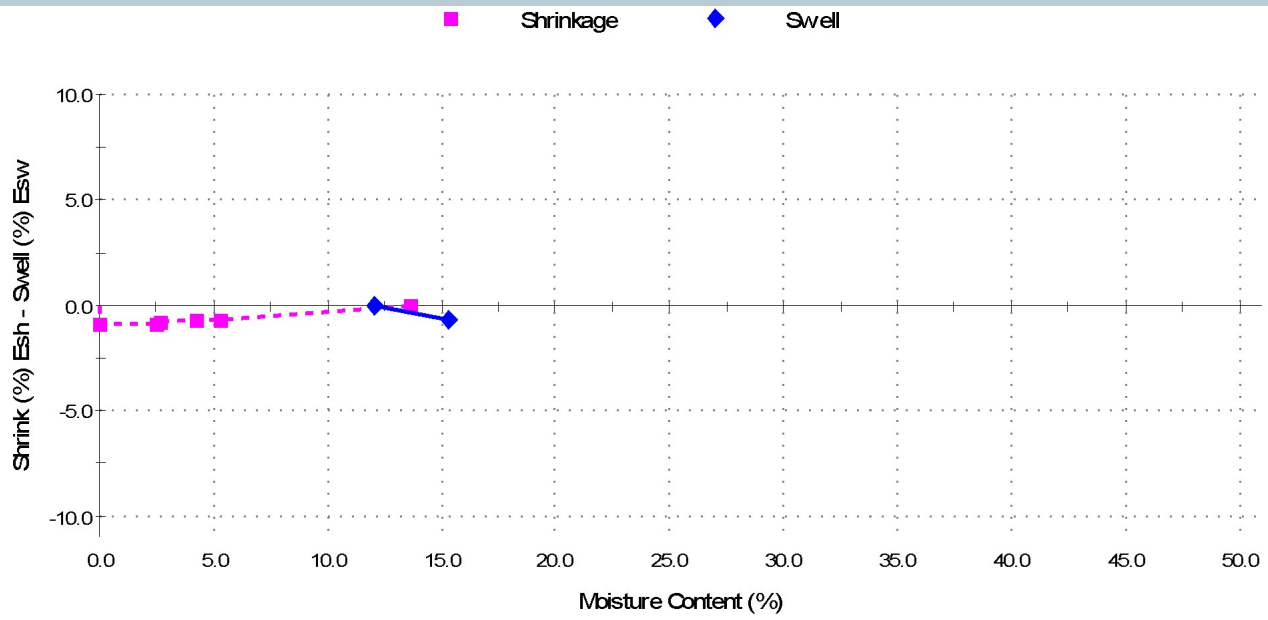
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.7
Moisture Content before (%):	12.0
Moisture Content after (%):	15.3
Est. Unc. Comp. Strength before (kPa):	240
Est. Unc. Comp. Strength after (kPa):	220

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	0.9
Shrinkage Moisture Content (%):	13.7
Est. inert material (%):	<5
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 0.5

Comments

Sandy Clay, medium plasticity, brown. fine to coarse grained sand.