QPRC HQ Development

Geotechnical Investigation Report

Queanbeyan-Palerang Regional Council

6 June 2019

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1. Introduction

1.1. Scope and Objectives

This report presents the results of a geotechnical investigation undertaken by D&N Geotechnical Pty Ltd (D&N), to support design of the proposed Queanbeyan-Palerang Regional Council (QPRC) Headquarters building (the site), located at 257 Crawford St, NSW.

The investigation was commissioned by QPRC, and carried out in general accordance with our fee proposal, D&N document Reference: C-0259.00, dated 29 January 2019, with the following exceptions:

- 3 cored boreholes advanced below target depth of 10 m to recover intact rock core; and
- Monitoring of 2 groundwater wells from a previous investigation, immediately adjacent to the site.

The objective of the geotechnical investigation was to assess subsurface conditions across the general site footprint, and to provide geotechnical recommendations to assist the structural engineer with design of the respective project elements. This report provides recommendations on foundation design parameters, excavation conditions/support requirements, earthworks, groundwater issues and earthquake design factors.

1.2. Project Appreciation

A previous geotechnical investigation has been undertaken for the project by Opus International Consultants (Australia) Pty Ltd, within the adjacent public car park area to the west of the current subject site (adjacent to 'The Q' theatre).

We understand that it is now preferred to construct the new QPRC Headquarters development over the footprint of the former Council Administration building as 257 Crawford Street, Queanbeyan NSW which is subject of this subsequent phase of geotechnical investigation.

At the time of commissioning, demolition works were underway; associated with removal of the former QPRC Administration building structure within the site footprint.

Following completion of demolition works, the project is expected to comprise construction of a 5 storeys commercial building over a single level of basement parking to provide a total GFA of about 7,500m^2, and occupy a building footprint of about 1,600m^2. The development will include a public domain area(s) comprising paved and lightly vegetated space.

2. Method of Investigation

2.1. Planning

Prior to commencement of fieldwork, D&N prepared a safety management plan. The field supervisor was provided with a hard copy of the plan, which was utilised on site for a subcontractor induction, and retained as a reference for emergency management.

D&N employees and subcontractors underwent a site induction which was provided by the demolition contractor immediately prior to commencement of our investigation works. Pre-start, daily toolbox meetings were held at the work site to assess specific hazards and update approaches to site works where the work activity/environment was observed to have changed.

Service plans were reviewed in detail prior to establishment for intrusive fieldwork and all borehole locations were cleared by a specialist service location contractor prior to commencement.

All fieldwork was carried out under the fulltime direction of a D&N engineering geologist, who was responsible for liaison with the demolition contractor, coordination of sub-contractors, management of site safety, logging of subsurface conditions and collection of soil samples for subsequent laboratory analysis.

2.2. Fieldwork

Fieldwork for the geotechnical investigation was carried out between 15 and 21 May 2019, and comprised the following main site activities:

- 3 x auger boreholes to depths of between 8 m and 10.8 m;
- 3 x cored boreholes to depths of between 11.28 m and 14.38 m;
- Installation of 1 groundwater monitoring well; and
- Sampling and testing of subsurface materials.

Subsequent groundwater monitoring was carried out on 31 May, 3 June and 5 June 2019. Groundwater monitoring is discussed in more detail in Section 2.4 below.

Boreholes were drilling using a trailer mounted drilling rig and initially advanced using auger or wash bore (rotary) drilling methods within soils, until the nominated target depth (8 m) or refusal within bedrock at between about 10.3 and 11.1 m depth. Standard Penetration Tests (SPT) were undertaken generally at 1.5 m intervals within soils to aid logging of subsurface conditions, collection of samples and to assess soil consistency/relative density.

Following refusal within bedrock, boreholes CBH01 to CBH03 were extended using NMLC diamond coring methods to recover between about 1 m and 3.2 m of intact rock core.

On completion, boreholes were backfilled with cuttings to surface, except for CBH02 which was completed as a groundwater monitoring well.

The groundwater monitoring well comprised a combination of slotted and blank PVC casing, with generally 6 m of slotted PVC from the base of the borehole, extended to the surface using blank PVC casing. The annulus between the PVC casing and the well bore was filled with graded sand and bentonite. The monitoring well was positioned below the current exposed building slab surface to reduce the risk of damage during currently ongoing demolition works.

Figure 1 shows the approximate borehole locations which were located using hand-held GPS equipment (accurate to ±3 m) and by using measurements from existing site features.

The engineering borehole logs and core photographs are presented in Appendix A.

2.3. Laboratory Testing

Selected soil samples were submitted to NATA accredited laboratories, for the following tests:

- 2 x Soil Aggressivity (pH, chloride, sulphate and electrical conductivity);
- 2 x Atterberg Limit, including Linear Shrinkage; and
- 2 x Particle Size Distribution.

Laboratory test results are further discussed in Section 3, test certificates are included as Appendix B.

2.4. Groundwater Level Monitoring

On completion of the groundwater monitoring well installation within CBH02, the well was purged to remove drilling muds.

A D&N engineering geologist subsequently attended site on 31 May and 3 June 2019 to monitor the standing water level. However, due to ongoing demolition works, the well location was not accessible with rubble placed over the surface at CBH02.

A further round of groundwater level monitoring was carried on 5 June 2019 to measure levels within nearby monitoring wells; installed during the previous geotechnical investigation carried out by Opus within the public car park to the west of the subject site.

Groundwater monitoring results are further discussed in Section 3.4.

3. Results of Investigation

3.1. Site Observations

The site is located at 257 Crawford Street, Queanbeyan NSW and occupies a footprint of approximately 1,600 m^2, and is bound to the north by The Queanbeyan Performing Arts Centre, to the east by Crawford Street road reserve, and the south and west by car parking and commercial buildings.

At the time of our investigation, demolition works were ongoing to remove the former QPRC Administration Building. Most of the former structure had been removed to expose a concrete slab over the majority of the site footprint with some partially demolished structure(s) within the north and eastern parts of the site.

Amongst other services, a major storm water channel passes through the middle of the site, orientated roughly east/west, immediately to the south of the proposed administration building.

3.2. Regional Geology

Reference to the 1:100,000 scale Geological Map of Canberra, Queanbeyan and surrounds (Sheet 8727, 1st edition, 1992), infers the site is underlain by middle to late Ordovician bedrock of the Pittman Formation; described as comprising interbedded sandstone, siltstone, shale and minor black shale, chert and impure calcareous sandstone.

3.3. Subsurface Conditions

The geotechnical profile at the site generally comprises FILL, overlying variable Quaternary Alluvium, underlain by sandstone bedrock at depths of between about 10.3 m and 11.1 m, where encountered.

Based on the findings of the borehole investigation, we have broadly inferred a subsurface profile into generalised geotechnical units for this report, as summarised in Table 1.

Table 2 provides a summary of the depth of occurrence and thickness of each respective geotechnical unit.

Table 1 - Summary of Geotechnical Units

Unit	Material Description
1	Former Building Slab – Concrete
	Fill – sandy Gravel, gravelly SAND, SAND, generally fine to coarse, sub-rounded to sub-angular, fine to coarse sand, pale grey, brown
2a	**Upper Alluvium** – clayey SILT, silty CLAY, sandy CLAY, low to medium plasticity, red-brown, varying amounts of sub-rounded to sub-angular gravel and fine sand, typically stiff consistency, with some firm or very stiff layers
2b	**Lower Alluvium** – SAND, gravelly SAND, clayey SAND, silty SAND, generally fine to coarse grained, sub-rounded to sub-angular, fine to coarse sand, brown. Fines are typically low to medium plasticity. Generally granular soils are medium dense.
3	**Bedrock** – interbedded siltstone, mudstone and sandstone, typically ranging from highly to moderately weathered, with some slightly weathered layers.

Table 2 - Depth of Occurrence and Thickness of Geotechnical Units

Unit	Material Origin	Depth Range to Top of Unit (m)	Range of Unit Thickness (m)
1	FILL	0.0	0.2 - 1.0
2a	Upper Alluvium	0.4 - 1.2	2.8 - 4.9
2b	Lower Alluvium	3.5 - 5.1	5.7 - 7.1
3	Highly to moderately weathered Bedrock [1]	10.3 – 11.1	To Limit of Investigation

Table 2 Notes:

1. Not observed within ABH01 or ABH02

3.4. Groundwater Conditions

Groundwater inflow was noted to occur during auger drilling at depths of between about 7.1 m and 7.5 m. Subsequent observation of groundwater inflows during wash boring and diamond rock coring were not possible as water was added to the boreholes as part of the drilling process.

Groundwater levels were monitored on 5 June 2019, and levels of between 7.2 m and 7.4 m were recorded. A summary of groundwater observations is presented below in Table 3.

Table 3 - Summary of Groundwater Observations

BH ID	Groundwater Inflow Depth During Drilling (m)	Monitored Groundwater Level (5 June 2019)
ABH01	7.2	-
ABH02	7.1	-
ABH03	7.3	-
CBH01	7.4	-
CBH02	7.5	not accessible
CBH03	-	-
Adjacent Site ‘A’	-	7.4
Adjacent Site ‘B’	-	7.2

Table 3 Notes

1. Adjacent Site ‘A’, next to BP Garage (MGA – 702904E 6085305N)
2. Adjacent Site ‘B’, next to the site (MGA – 702960E 6085395N)

3.5. Laboratory Testing

Laboratory test certificates are included as Appendix B and summarised in Tables 4 and 5 below.

Table 4 - Summary of Soil Classification Laboratory Test Results

BH ID	Depth (m)	Grading (%)			LS (%)	PI (%)	LL (%)	PL (%)	Field MC (%)
		Fines	Sand	Gravel					
BH02	1.0 – 1.45	81	100	0	8.5	14	32	18	16.0
BH03	1.0 – 1.45	73	25	2	-	9	30	21	6.2

Table 5 - Summary of Soil Aggressivity Laboratory Test Results

BH ID	Depth (m)	pH	Chloride (mg/kg)	Sulphate (mg/kg)	Electrical Conductivity (dS/m)
CBH03	2.5	7.4	56	70	0.02
CBH01	2.5	7.4	56	98	0.04

4. Discussions and Recommendations

4.1. Earthworks

4.1.1. *Presence of Fill*

The investigation indicates that Unit 1 Fill extends across the site to depths of up to 1.1 m depth, or deeper; comprising the former QPRC building slab, underlain by granular soils.

The fill appears to be related to the previous building and is expected to have varying density/consistency. Deeper fill is expected to be localised, associated with underground services, not limited to the stormwater alignment passing through the site.

Unless there are records confirming that any fill has been compacted in accordance with an engineering specification, it should be classified as 'uncontrolled' and should not be used as a foundation for structures or pavements in its current condition due to the potential for differential settlement.

Therefore, we consider that where structure footings or pavements are proposed, this material should be excavated and re-compacted (if suitable) or replaced with a select fill material up to design subgrade level.

4.1.2. *Site Preparation and Fill Placement*

Where Unit 2a Alluvial Soils (stiff CLAY/SILT) are exposed at subgrade, the foundation level should not require extensive treatment; provided it is not disturbed by traffic or water ingress. Where predominantly silty soils are exposed, they will be highly susceptible to disturbance and may need to be removed if affected by water ingress and cannot be readily compacted.

Where natural soils are exposed and no filling is required, pavement subgrade and foundation preparation should consist of bulk excavation to subgrade or foundation level followed by geotechnical assessment of the exposed stratum. If assessed to be suitable, the foundation should be poured shortly thereafter, or blinded to prevent softening due to moisture ingress. Pavement subgrades should be graded to drain effectively and should be cleaned of any softened material prior to placement of pavement materials.

General guidelines for earthworks are as follows:

- Strip all topsoil and unsuitable material such as softened or heaving soils, if present;
- Box out pavements to proposed subgrade level if this is deeper than the stripped level;
- If Engineered Fill is to be placed to achieve pavement subgrade level or foundation level, then compact in maximum 0.3 m loose thickness layers, as outlined below;
- Once pavement subgrade level is achieved, proof roll the entire road formation with at least 4 passes of a non-vibratory minimum 10 tonne dead weight smooth drum roller. Any soft or heaving areas should be excavated and replaced with compacted fill;
- All Engineered Fill and natural material at depths within 0.3 m of pavement subgrade level should be compacted to achieve a minimum Dry Density Ratio of 100% Maximum Dry Density (SMDD) and moisture conditioned to Standard Optimum Moisture Content (SOMC) ± 2% at the time of compaction;
- All Engineered Fill at depths greater than 0.3 m below pavement subgrade level and to foundation level for structures should be compacted to achieve a minimum Dry Density Ratio of 98% (SMDD) and moisture conditioned to SOMC ± 2% at the time of compaction.

All compacted replacement fill and subgrade preparation should be constructed under Level 1 geotechnical inspection and testing as defined in AS3798-2007. Where earthworks proceed in minor stages and are not continuous, geotechnical inspection and testing to Level 2 as defined in AS3798-2007 would be suitable.

4.1.3. *Subgrade Trafficability*

Removal of existing fill is expected to expose a subgrade comprising predominantly silty and/or clayey soils. These materials are expected to behave poorly if exposed to heavy construction traffic, particularly when wet. A platform of granular material such as road base or crushed concrete may be needed to support construction plant. Where heavy plant such as piling rigs, or mobile cranes are to traffic the site, specific analysis of working platform requirements may be required to assess working platform thickness.

To help reduce, but not eliminate, trafficability issues associated with wet weather, exposed subgrades should be graded such that they promote surface drainage and prevent ponding.

4.1.4. *Re-use of Site Won Materials*

From a geotechnical viewpoint, Unit 1 Fill, Unit 2 soils and Unit 3 weathered bedrock should generally be suitable for use as Engineered Fill, provided unsuitable materials such as organics, waste or oversized particles are removed.

The project geotechnical consultant should verify the suitability of excavated material for re-use as Engineered Fill during construction.

Highly silty soils such as those observed within Unit 2a Upper Alluvium will be sensitive to variations in moisture content and may be difficult to re-compact.

4.2. Bulk Excavations

We understand that the currently proposed development will include a 1 level basement car park below about half of the new HQ building. Excavation in the order of 3 m to 4 m below current site surface levels is expected, early sketch plans indicate a finished basement level of about RL 572.6 m.

4.2.1. *Excavation Conditions*

Bulk excavation for a single basement level will likely penetrate Unit 1 Fill, Unit 2a Upper Alluvium and in some areas Unit 2b Lower Alluvium. Therefore, materials exposed at the finished basement level are expected to be variable, comprising Unit 2a and Unit 2b. Excavation with these soil units should be possible using conventional earth moving plant such as hydraulic excavators fitted with rock teeth.

In any case, excavation contractors should be provided with the Engineering Borehole Logs and core photographs and be required to make their own assessment of the suitability and productivity of excavation plant.

4.2.2. *Groundwater Conditions*

The results of this geotechnical investigation indicate a standing groundwater level at the site of between about 7.1 and 7.5 m depth, which indicates a standing groundwater level of about RL 568.5 m.

Based on the proposed basement level (3 m - 4 m), bulk excavations are not expected to encounter permanent standing groundwater. Excavations below this depth for building footings or lift pit(s) are likely to extend below standing groundwater level.

Due to the presence of highly permeable layers, particularly within the Unit 2b lower alluvial soils, and near vertical joints/defects throughout the rock mass, potentially high groundwater inflow rates may occur within excavations below standing groundwater, beyond levels which can be economically managed using conventional sump pumping methods.

Standing groundwater levels are expected to vary in response to climatic conditions and higher groundwater levels are likely to occur during and following significant rainfall events.

4.2.3. *Unsupported Excavations*

Unsupported excavations may be practicable where there is sufficient space and where sensitive structures, or underground services are not located within a distance from the crest equal to the depth of excavation. For preliminary assessments, the batter slopes in Table 6 can be assumed for preliminary design of unsupported excavations. Final selection of excavation batter slopes is ultimately the responsibility of the site operator.

Table 6 - Recommended Preliminary Unsupported Batter Slopes

Unit	Material Origin	Temporary Batters	Permanent Batters
-	Controlled Fill[1]	1(H):1(V)	2(H):1(V)
1	Uncontrolled Fill[1]	1.5(H):1(V)	3(H):1(V)
2	Alluvium[1]	1.5(H):1(V)	2(H):1(V)
3	Bedrock[1 & 2]	0.75(H):1(V)	1(H):1(V)

Table 6 Notes:

1. Protection against erosion may be required
2. Unlikely to be encountered within a 4 m excavation

The above recommended batters are based on there being no structures or surcharge located at or near the crest of cuts/fills. Steeper slopes in the fill, soil and weathered rock materials would require engineer design retaining structures. Site specific advice is required for unsupported cuts greater than 3 m in height.

If there is insufficient room to form the above temporary batters, excavations extend below standing groundwater, or excavations form part of the permanent structure, then a retention system will be required.

4.2.4. *Supported Excavations*

The site is consistently underlain by two distinct alluvium units, comprising clays and silts (upper Alluvium) underlain by sand and gravel (lower Alluvium). The alluvium unit is underlain by weathered bedrock at between 10 m and 11 m depth below existing surface level(s). Bulk excavation at the site is expected to extend to a maximum depth of 4 m associated with a single basement level.

Standing groundwater was monitored at between about 7.1 m and 7.5 m below current surface level(s), within the lower alluvial sands and gravels (Unit 2b). The site lies within a marginally elevated location with respect to Queanbeyan River, approximately 275 m beyond the eastern site boundary. However, it is expected that a higher groundwater table may develop during periods of wetter weather.

Therefore, short term build-up of hydrostatic pressures could occur during prolonged wet periods or due to broken services, hence the possibility of hydrostatic pressures that could extend to the ground surface should be considered.

Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures, and hydrostatic pressure. If drained walls are to be used then adequate drainage will need to be provided behind the walls, and a permanent water collection system will be required together with flushing points for drainage system periodic maintenance. Nevertheless, an allowance of potential water pressure build-up equivalent to one-third the wall height is prudent with such drainage measures installed.

We understand that the proposed development will require excavation for one basement level and as such temporary and permanent retention systems are likely to be required. Retention systems that could be considered include:

- Sheet Piled Walls;
- Contiguous Piled Walls;
- Secant Piled Walls;
- Soil Nail Walls.

For a sheet piled wall, overlapping or interlocking sheets would be vibrated or driven into the ground around the proposed basement perimeter prior to excavation. As the excavation proceeds, the sheet pile wall would require stiffening with horizontal beams, cross struts and/or temporary anchors. The new structure would be built inside the sheet pile wall with temporary support measures progressively removed as basement walls are constructed in lifts. The steel sheet piles could be used to provide formwork for the permanent basement walls, but this would preclude their recovery. Sheet piles would likely refuse on the weathered bedrock, and groundwater seepage may occur through the clutches and toe of the wall. Noise and vibration issues would also need to be considered.

Contiguous piles could be adopted, however with such a system gaps between the piles may allow granular soils (particularly where excavation extends into Unit 2b) to run into the excavation de-stabilising the ground behind the piles and risking undermining of adjacent structures. The risk of running sands is greatest if saturated sands are encountered (generally below 7 m depth). Careful construction procedures would be a required with allowance for progressive grouting of gaps between piles for this system to provide effective temporary and permanent support.

Secant piling involves drilling “soft” piles using low strength concrete at centres of 1.5 x pile diameters. Normal strength “hard” piles are then drilled between, cutting into the soft piles to form a relatively watertight seal. The secant pile wall would be installed around the proposed basement perimeter down into bedrock prior to excavation and would likely require the progressive installation of ground anchors to provide additional lateral stability to the wall as the excavation proceeds. Unless driven carefully, secant piles can deviate off vertical centre during installation creating gaps between the piles and therefore significantly increasing the potential for groundwater seepage and ground loss through the wall.

For the design of retaining walls a triangular earth pressure distribution can be adopted to calculate earth pressures for relatively flexible shoring systems such as cantilevered walls or walls supported by a single row of props or anchors.

The horizontal earth pressure profile may be calculated using the following formula:

$$p = K (\gamma' z + p_s)$$

where p = lateral earth pressure (kPa)

K = earth pressure coefficient, to be selected depending considering the amount of movement that can be tolerated.

γ' = effective unit weight (kN/m^3)

z = depth below top of excavation (m)

H = height of excavation at base of excavation (m)

p_s = design uniform surcharge pressure at ground level

Flexible shoring systems such as cantilevered walls should be avoided where there is a risk of movement damaging structures or services adjacent to an excavation.

Design of braced shoring or permanent retaining structure walls, which are constrained at several levels can be based on a trapezoidal earth pressure distribution. Where retention of a multi-layered material profile is required, modification of the distribution (including the definition of H) will be necessary.

Table 7 - Trapezoidal Pressure Distribution

Depth	Horizontal Pressure (kPa)
0	$K.p_s$
0.25 H	$K (0.8.\gamma'.H + p_s)$
0.75 H	$K (0.8.\gamma'.H + p_s)$
H	$K.p_s$

Earth pressure coefficients are provided in Table 8 below, for the following cases:

- Case 1 = temporary retention, no adjacent footings.
- Case 2 = permanent retention, no adjacent footings.
- Case 3 = adjacent footings and hence need to limit movement.

Table 8 - Earth Pressure Coefficients

Geotechnical Unit	Value of Lateral Earth Pressure Coefficient, K[1]			Passive Earth Pressure Coefficient, Kp[1]	Bulk Density (kN/m^3)
	Case 1	Case 2	Case 3		
Fill and Alluvial Soil	0.3	0.35	0.5	2.5	20

Table 8 Note:
1.These values are only applicable for a horizontal ground surface.

Where ground anchors are required to restrict retaining wall movement, or where there is a need to limit ground movement, higher earth pressure coefficients should be adopted. We recommend an earth pressure coefficient of 0.5 for propped or anchored retaining walls where movements are restrained and a trapezoidal earth pressure distribution.

In addition to lateral earth pressures and surcharge loads, consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall (e.g. from broken services) unless permanent subsurface drainage can be provided.

4.2.5. *Temporary Soil Nails*

Temporary anchors required to support retaining walls may need to be angled steeply to develop bonded lengths in the soil. For preliminary design, the following allowable bond stresses can be adopted:

Unit 2a Upper Alluvium	40 kPa
Unit 2b Lower Alluvium	35 kPa

Anchors should be designed for both bond failure and cone pull-out mechanisms. Temporary anchors should be proof loaded to at least 1.3 times the anchor working load.

4.2.6. *Potential Effect of Adjacent Structures*

The location, footing type, layout and founding depth for adjacent structures should be determined before excavation commences. Where adjacent structures are located within the zone of influence of the excavation (nominally a line extending at a slope of 1H:1V up from the base of the proposed excavation), the foundation stratum may experience horizontal and vertical movements from excavation induced ground movements due to retention deformation and this should be adequately assessed as part of excavation retention design.

Additionally, the potential effects of noise and vibration on adjacent structures results from excavation equipment and methods, particularly where excavation of hard rock is required, will need to be carefully considered by the contractor as part of the construction management plan.

It may be necessary to limit the size of excavation plant such as impact hammers and/or limit the use of impact hammers within determined distances of sensitive receptors.

The vibration limits in Table 9 are commonly recommended to reduce the risk of vibration damage to sensitive receptors.

Table 9 - Ground Vibration Limits for Various Structures (DIN 4150-3-1999)

Structure	Guideline Values for Velocity vi(t) [mm/s]		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100Hz
Reinforced Concrete Commercial Buildings in Good Condition	20	20 to 40	40 to 50
Residential Dwellings or Low Rise in Good Condition	5	5 to 15	15 to 20
Sensitive Structures (e.g. heritage listed)	3	3 to 8	8 to 10

Dilapidation surveys should be carried out on neighbouring structures or sensitive services prior to commencing excavation. Vibration trials should be carried out to assess appropriate distances for the plant to be used on site to limit vibrations. Vibration monitoring should continue during site works to confirm that the limits are not exceeded.

The proposed excavation will cause some ground movements. Many factors can influence the size of these movements, from ground conditions to design and construction quality. Documented data has shown that for well-designed and constructed shoring, vertical and lateral movements can be about 0.1%

to 0.3% of the retained thickness of stiff clay and medium dense sand soils. If this aspect is critical, we can assess (possibly by numerical analysis) likely ground movements during design of the shoring system.

4.3. Building Foundations

The findings of our investigation indicate that subsurface conditions across the general site footprint are variable, and that bulk excavation for one basement level is likely expose Unit 2a Upper Alluvium and/or Unit 2b Lower Alluvium.

Column loads are not currently known to D&N. Due to the deep alluvial profile; piled foundations may be required to transfer column loads to the underlying bedrock. Some smaller structures, e.g. single level buildings may be supported on shallow spread footings.

4.3.1. *Spread Foundations*

Pad or strip footings may be proportioned based on the following allowable bearing pressures:

Table 10 - Recommend Allowable Bearing Pressures for Pad/Strip Footings

Unit	Material Origin	Allowable Bearing Pressure (kPa)
	Controlled Fill	100
2a/2b	Alluvium	150
3	Bedrock	2,000

The above values assume all footings extend a minimum of 0.5 m below the prepared subgrade surface levels. Isolated footings will need to be dimensioned to consider uplift and lateral loads.

To reduce the potential for differential settlement between building footings, we recommend that all footings be founded within the same geotechnical unit. Footings proportioned in accordance with the above recommendation should have load induced settlements of no greater than 1% of the footing width. Footing design will need to consider the presence of existing site services, which may require some form of spanning and/or localised deepening of footings.

The recommended allowable bearing pressures provided above assume that the bearing surfaces are clean and free from spoil and other soft and loose material, and free of water at the time of placement of concrete. We recommend that concrete for pad or strip footings be poured or a blinding layer of concrete be placed on any founding surfaces as soon as practical to limit the disturbance to the surface and any likely degradation of the exposed materials.

On excavation, should the ground conditions differ from those outlined above, further advice should be sought from D&N.

4.3.2. *Deep Foundations*

Where Unit 2 Alluvium is present to an uneconomical depth, or where design loads exceed the above provided allowable bearing pressures; piled footings may be required to transfer column loads to the underlying Unit 3 bedrock.

Groundwater will be encountered, and provision would need to be made for temporary support and for dewatering of open bored piles. Alternatively, Continuous Flight Auger (CFA) piles could be adopted that would not need casing or other support.

For limit state design, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (ϕ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 11 below for Unit 3 weathered bedrock:

Table 11 - Recommended Geotechnical Parameters for Piled Foundations

Unit / Origin	Unit Weight (kN/m^3)	Ultimate End Bearing Capacity (MPa)	Ultimate Skin Friction (kPa)	Elastic Modulus (MPa)
Unit 3 Bedrock	22	6	400	300

For uplift loads the shaft adhesion value above should multiplied by a factor of 0.6, in addition to the geotechnical strength reduction factor.

The recommended design parameters assume that the bearing surfaces are clean and free from spoil and other soft and loose material and free of water at the time of placement of concrete. On excavation, should the ground conditions differ from those outlined above then further advice should be sought from D&N. The above values for shaft adhesion assume that the walls of the shaft are suitably roughened and cleaned of smear. If the pile holes cannot be dewatered sufficiently then tremmie grouting should be employed to displace the water from the pile hole.

Where rock sockets are required to resist compression and uplift loads allowance should be made for high capacity piling rigs fitted with rock teeth and coring buckets, as required.

For limit state design, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (ϕ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 11.

In accordance with AS2159-2009, ϕ_g is dependent on an Average Risk Rating (ARR) which considers various geotechnical uncertainties, foundation system redundancy, construction supervision, quantity and type of pile testing.

We've conducted a preliminary assessment of ARR and ϕ_g values given the extent of geotechnical investigations performed and findings at this site, based on the following assumptions:

- Moderate redundancy foundation system
- The design will be carried out by an experienced engineering professional using well-established and soundly based methods
- Well established construction processes will be adopted, and detailed professional geotechnical supervision will be provided during pile construction
- Performance of the supported structure is not monitored.

Based on our current understanding of the project and the above assumptions, the following preliminary values have been assessed:

- Average Risk Rating = 2.8
- Geotechnical strength reduction factor, ϕ_g, 0.55 assuming no pile testing is undertaken.

Testing may provide the degree of confidence required to achieve a higher ϕ_g value and more economical design. D&N would be pleased to review the final ϕ_g selection at the detailed design stage.

Limit state design also requires assessment of the serviceability performance of the foundation system, including pile group interaction effects. This should be carried out by experienced geotechnical professional using well-established and soundly based methods. The modulus value given in Table 11 can be used, though the accuracy of settlement prediction is dependent on construction methods as well as material stiffness, both of which can involve considerable uncertainty. Settlement predictions can have a large margin for error, and in some cases serviceability pile load testing should be completed when foundation settlement is critical to the structure's performance.

4.4. Earthworks Design

Based on AS1170.4-2007 the following parameters should be adopted for seismic design:

- Seismic Hazard Factor (Z) 0.08
- Sub-Soil Class Ce

4.5. Soil Aggressivity

The results of Soil Aggressivity testing were assessed in accordance with Australian Standard AS2159-2009 Piling – "Design and Installation". Chemical tests indicated that all soils below the water table are to be treated as mildly aggressive, and all soils above the groundwater are to be treated as non-aggressive.

5. Limitations

Subsurface conditions can be complex and may vary over relatively short distances – and over time. The inferred geotechnical model and recommendations in this report are based on limited subsurface investigations at discrete locations. The engineering logs describe subsurface conditions only at the investigation locations.

Further investigations may be required to support detailed design if there are scope limitations or changes to the nature of the project. We can assist with detailed design and/or to review designs and verify that the conditions exposed are consistent with design assumptions during construction.

Figures

QPRC Headquarters

16612700 16612800

-4187400 -4187500

Legend

- Boreholes

Data Source:

https://data.nsw.gov.au/data/

Cartographic Data and Orientation:

N

1:700
Datum: WGS84
Universal Transverse Mercartor

0 20 m

D&N Geotechnical

Company: D&N Geotechnical
Drawn: Leandro E de Souza
Approved: Dan Butterworth
Original size: A3
Project: QPRC Headquarters
Project number: C-0259.00

Date:	Client:	Figure number:
05/06/2019	QPRC	1

Appendix A - Engineering Borehole Logs and Core Photographs

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Engineering Log - Borehole

Borehole ID.	**ABH01**
sheet:	1 of 1
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***21 May 2019***
principal:	
date completed:	***21 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703058; N: 6085345 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer 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					0.0			**FILL: CONCRETE**: (100 mm thickness).	D			**BUILDING SLAB**
								FILL: Sandy GRAVEL: fine to coarse grained, sub-rounded to sub-angular, fine sand.				**FILL**
							ML	**Clayey SILT**: low liquid limit, red-brown, brown.	<Wl	St		**UPPER ALLUVIUM**
			SPT 8, 9, 14 N=23		1.0		CL-Cl	**Silty CLAY**: low to medium plasticity, red-brown, with some fine, sub-rounded to sub-angular gravel, and fine sand.	<Wp			
			SPT 8, 8, 16 N=24		2.0							
					3.0							
			SPT 7, 9, 11 N=20		4.0							
					5.0		SP	**SAND**: fine to medium grained, pale brown, with some fine sub-rounded to sub-angular gravel.	M	MD		**LOWER ALLUVIUM**
			SPT 5, 6, 6 N=12		6.0							
							SW	**Gravelly SAND**: fine to coarse grained, pale brown, fine to coarse, sub-rounded to sub-angular gravel.				
			SPT 6, 9, 12 N=21		7.0				W			

Borehole ABH01 terminated at 8.0 m
Target depth

D&N_AU_LIBRARY.GLB rev:AM Log COF BOREHOLE: NON CORED PROJ0259.GPJ <<DrawingFile>> 05/06/2019 11:01

method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore

* 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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**ABH02**
sheet:	1 of 1
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***15 May 2019***
principal:	
date completed:	***15 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703056; N: 6085332 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer 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					0.0			**CONCRETE**: (100 mm thickness).	D			**CONCRETE SLAB**
								FILL: Gravelly SAND: fine to coarse grained, dark brown, fine to coarse, sub-rounded to sub-angular gravel.				**FILL**
			SPT 8, 11, 12 N=23		1.0		Cl	**Silty CLAY**: medium plasticity, dark brown, mottled black, traces of fine, sub-rounded to sub-angular gravel.	<Wp	F to St		**UPPER ALLUVIUM**
			SPT 5, 5, 6 N=11		2.0		Cl	**CLAY**: medium plasticity, brown, mottled red-brown, with some fine sand, traces of fine, sub-angular gravel.				
			SPT 4, 4, 7 N=11		4.0							
			SPT 3, 4, 7 N=11		5.0		SC	**CLAYEY SAND**: fine grained, pale brown, medium plasticity clay fines, with some fine, sub-rounded to sub-angular gravel.	M	MD		**LOWER ALLUVIUM**
					6.0		SP	**Gravelly SAND**: fine to coarse grained, pale brown, orange-brown, fine to coarse, rounded to sub-rounded gravel, with some medium plasticity clay fines.				
N		▶	SPT 4, 7, 9 N=16		7.0				W			

Borehole ABH02 terminated at 8.0 m
Target depth

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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.	**ABH03**
sheet:	1 of 2
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***20 May 2019***
principal:	
date completed:	***20 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703070; N: 6085352 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration	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)	structure and additional observations
AD/T, N	1 2 3				0.0			**FILL: CONCRETE**: (100 mm thickness).	D			**BUILDING SLAB**
								FILL: Gravelly SAND: medium to coarse grained, pale grey, fine to coarse, sub-rounded to sub-angular gravel.				**FILL**
							ML	**FILL: SAND**: fine to medium grained, brown, with some fine to medium, sub-rounded to sub-angular, gravel.	<Wl	VSt		**UPPER ALLUVIUM**
			SPT 7, 11, 16 N=27		1.0			**Clayey SILT**: low liquid limit, pale brown, mottled red-brown, trace of fine sand.				
					2.0		CL	**Silty CLAY**: low plasticity, red-brown, pale brown, with some fine to coarse, sub-rounded to sub-angular gravel.	<Wp			
			SPT 12, 16, 19 N=35		3.0		SW	**SAND**: fine to coarse grained, pale brown, brown, with some fine to coarse, sub-rounded to sub-angular gravel.	D	MD		**LOWER ALLUVIUM**
			SPT 6, 7, 8 N=15		4.0		SP	**SAND**: fine grained, pale brown, brown, with some fine to medium, sub-rounded to sub-angular gravel, trace of medium plasticity clay fines.				
			SPT 7, 7, 9 N=16		5.0							
					6.0		SW	**SAND**: fine to coarse grained, pale brown, brown, with some fine to coarse, sub-rounded to sub-angular gravel.				
			SPT 9, 11, 12 N=23		7.0				W			

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**ABH03**
sheet:	2 of 2
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***20 May 2019***
principal:	
date completed:	***20 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703070; N: 6085352 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer 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)	structure and additional observations
AD/T, N					9.0		GW	**Sandy GRAVEL**: fine to coarse grained, rounded to sub-angular, brown, pale brown, fine to coarse sand.	W	MD		**LOWER ALLUVIUM**
					10.0			**SANDSTONE**: fine to medium grained, pale grey, dark grey, extremely weathered, very low to low strength.				**BEDROCK**
					11.0			Borehole ABH03 terminated at 10.80 m Refusal				
					12.0							
					13.0							
					14.0							
					15.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**CBH01**
sheet:	1 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***15 May 2019***
principal:	
date completed:	***16 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703055; N: 6085320 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

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					0.0			**CONCRETE**: (100 mm thickness).	D			**BUILDING SLAB**
								FILL: Gravelly SAND: fine to coarse grained, pale brown, dark brown, dark grey, fine to coarse, sub-angular to angular gravel.				**FILL**
			SPT 5, 5, 7 N=12		1.0		Cl	**Silty CLAY**: medium plasticity, brown, mottled pale brown, traces of fine, sub-rounded to sub-angular gravel.	<Wp	St		**UPPER ALLUVIUM**
			SPT 5, 6, 8 N=14		2.0							
					3.0		Cl	**Sandy CLAY**: medium plasticity, pale brown, mottled red-brown, fine sand.				
			SPT 5, 7, 6 N=13		4.0							
							SM	**Clayey SILTY SAND**: fine grained, pale brown, medium plasticity clay fines.	M	MD		**LOWER ALLUVIUM**
			SPT 4, 9, 10 N=19		5.0							
					6.0		SW	**Gravelly SAND**: fine to coarse grained, pale brown, red-brown, fine to coarse, sub-angular gravel, with medium plasticity clay fines.				
NW casing			SPT 6, 7, 9 N=16		7.0				W			

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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.	**CBH01**
sheet:	2 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***15 May 2019***
principal:	
date completed:	***16 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703055; N: 6085320 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

drilling information | **material substance**

method & support	penetration	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)	structure and additional observations
AD/T, NW casing	1 2 3				9.0		SW	**Gravelly SAND**: fine to coarse grained, pale brown, red-brown, fine to coarse, sub-angular gravel, with medium plasticity clay fines. *(continued)*	W	MD	100 200 300 400	**LOWER ALLUVIUM**
W					10.0		GP	**Sandy GRAVEL**: fine to coarse grained, pale brown, with some fine to coarse sand. Borehole CBH01 continued as cored hole				
N					11.0							
					12.0							
					13.0							
					14.0							
					15.0							

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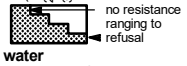
method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

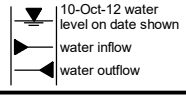
* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration



water



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

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**CBH01**
sheet:	3 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***15 May 2019***
principal:	
date completed:	***16 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703055; N: 6085320 (WGS84 Zone 55) surface elevation: Not Specified angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted drilling fluid: Water casing diameter : NW 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
			9.0								
			10.0		start coring at 10.27m						
NMLC			11.0		**SANDSTONE**: fine grained, pale grey, pale brown, with quartz veins.	MW	O	d=2.18 a=0.60	82%		JT, 60 - 80°, PL, SO, CN JT, 50°, PL, SO, VN JT, 80°, PL, SO, VN JT, 80°, PL, SO, VN JT, 90°, PL, SO, SN JT, 60 - 80°, PL, SO, CN JT, 45°, PL, SO, VN Highly Fractured
					Borehole CBH01 terminated at 11.28 m Target stratum						
			12.0								
			13.0								
			14.0								
			15.0								

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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

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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CBH01

Core Photograph

Job No: C-0259.00 Sheet 1 of 1
Office: Canberra

Client: QPRC	Date: 16 May 2019
Principal:	By: LC
Project: QPRC HQ	Location: 257 Crawford St, Queanbeyan NSW

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**CBH02**
sheet:	1 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***17 May 2019***
principal:	
date completed:	***17 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703035; N: 6085340 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

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					0.0			**CONCRETE**: (100 mm thickness).				**BUILDING SLAB**
								FILL: Gravelly SAND: fine to coarse grained, pale brown, fine to coarse, sub-angular to angular gravel.	D			**FILL**
							ML	**Clayey SILT**: low liquid limit, dark brown, trace of fine, sub-angular gravel.	<Wl	St		**UPPER ALLUVIUM**
			SPT 7, 9, 9 N=18		1.0							
							Cl	**Silty CLAY**: medium plasticity, dark brown, trace of fine, sub-angular gravel.	<Wp			
			SPT 4, 8, 8 N=16		2.0							
					3.0							
			SPT 6, 6, 8 N=14		4.0							
							SM	**SILTY SAND**: fine grained, pale brown, reddish brown, with some medium plasticity clay fines.	M	MD		**LOWER ALLUVIUM**
			SPT 4, 6, 8 N=14		5.0							
					6.0		SP	**SAND**: medium to coarse grained, pale brown, with some fine to medium, sub-rounded to rounded gravel.				
							SP	**Gravelly SAND**: medium to coarse grained, pale brown, dark brown, medium to coarse, sub-rounded to rounded gravel.				
			SPT 7, 6, 8 N=14		7.0							
W									W			

NW casing

D&N_AU_LIBRARY.GLB rev:AM Log COF BOREHOLE: NON CORED PRO.J0259.GPJ <<DrawingFile>> 05/06/2019 11:01

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**CBH02**
sheet:	2 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***17 May 2019***
principal:	
date completed:	***17 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703035; N: 6085340 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

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
W NW casing					9.0		SP	**Gravelly SAND**: medium to coarse grained, pale brown, dark brown, medium to coarse, sub-rounded to rounded gravel. *(continued)*	W	MD		**LOWER ALLUVIUM**
							GP	**Sandy GRAVEL**: medium to coarse grained, sub-rounded to angular, brown, grey, pale brown, medium to coarse sand.				
					10.0							
					11.0			Borehole CBH02 continued as cored hole				
					12.0							
					13.0							
					14.0							
					15.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**CBH02**
sheet:	3 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***17 May 2019***
principal:	
date completed:	***17 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703035; N: 6085340 (WGS84 Zone 55) surface elevation: Not Specified angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted drilling fluid: Water casing diameter : NW 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
			9.0								
			10.0								
			11.0		start coring at 11.14m						
NMLC			12.0		**SILTSTONE**: pale grey, dark grey.	MW to SW		a=0.18	0%		Defects are: JT, 20 - 50°, PL, SO, SN, unless otherwise described
									56%		
						HW to MW		d=0.25			JT, IR, RO, VN Extremely Fractured
			13.0						57%		JT, 0 - 20°, PL, SO, SN JT, 0 - 20°, PL, SO, SN JT, 0 - 20°, PL, SO, SN
					INTERBEDDED SILTSTONE (80%) AND MUDSTONE (20%): pale grey, dark grey, with quartz veins infilling some partings and joints.						JT, 0 - 20°, PL, SO, SN JT, 45°, IR, RO, VN
								d=0.84	59%		JT, 45°, IR, RO, VN Extremely Fractured
			14.0								JT, 30°, IR, RO, VN Extremely Fractured
					Borehole CBH02 terminated at 14.38 m Target stratum						
			15.0								

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

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

D&N Geotechnical

CBH02

Core Photograph

Job No: C-0259.00 Sheet 1 of 1
Office: Canberra

Client: QPRC	Date: 17 May 2019
Principal:	By: LC
Project: QPRC HQ	Location: 257 Crawford St, Queanbeyan NSW

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**CBH03**
sheet:	1 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***20 May 2019***
principal:	
date completed:	***21 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703073; N: 6085323 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

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 Observable			0.0			**FILL: Silty CLAY**: medium plasticity, reddish brown, orange brown.	D			**FILL**
			SPT 4, 5, 5 N=10		1.0		CI-CH	**CLAY**: medium to high plasticity, dark brown, reddish brown.	<Wp	F - St		**UPPER ALLUVIUM**
			SPT 5, 5, 5 N=10		2.0							
					3.0							
			SPT 7, 7, 6 N=13		4.0							
					4.0		SP	**SAND**: medium to coarse grained, pale brown, brown, with some fine to coarse, sub-angular to sub-rounded gravel, trace of medium plasticity clay fines.	D	MD		**LOWER ALLUVIUM**
					5.0							
W					6.0							
NW casing					7.0				W			

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Borehole

Borehole ID.	**CBH03**
sheet:	2 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***20 May 2019***
principal:	
date completed:	***21 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703073; N: 6085323 (WGS84 Zone 55) | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted | drilling fluid: Water | casing diameter : NW

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
W NW casing		Not Observable					SP		W	MD		**LOWER ALLUVIUM**
							GP	**Sandy GRAVEL**: medium to coarse grained, rounded to sub-rounded, brown, pale brown, medium to coarse sand.				
					9.0							
					10.0							
					11.0			Borehole CBH03 continued as cored hole				
					12.0							
					13.0							
					14.0							
					15.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* 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

D&N Geotechnical

Engineering Log - Cored Borehole

Borehole ID.	**CBH03**
sheet:	3 of 3
project no.	**C-0259.00**
client:	***Queanbeyan-Palerang Regional Council***
date started:	***20 May 2019***
principal:	
date completed:	***21 May 2019***
project:	***New QPRC Headquarters Development***
logged by:	***LS***
location:	***257 Crawford Street, Queanbeyan NSW***
checked by:	***DB***

position: E: 703073; N: 6085323 (WGS84 Zone 55) surface elevation: Not Specified angle from horizontal: 90°

drill model: Gemco 210B, Trailer mounted drilling fluid: Water casing diameter : NW 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
			9.0								
			10.0								
			11.0		start coring at 11.00m						
NMLC	Not Observable		12.0		**INTERBEDDED SANDSTONE (70%) AND SILTSTONE (30%)**: fine to medium grained, dark brown, pale brown, with calcite veins.	MW to SW		a=0.27 d=0.51 d=0.45 d=0.62 d=0.86	100% 58% 81% 74%		JT, 80 - 90°, IR, RO, SN JT, 80 - 90°, IR, RO, SN Extremely Fractured JT, 80 - 90°, IR, RO, SN JT, 80 - 90°, IR, RO, SN JT, 80 - 90°, IR, RO, SN SS, 90°, ST, SO, CN PT, 30°, PL, SO, CN PT, 30°, PL, SO, CN
			13.0		Borehole CBH03 terminated at 13.65 m Target stratum						
			14.0								
			15.0								

Defects are: JT, 30 - 50°, UN, 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

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

D&N Geotechnical

CBH03

Core Photograph

Job No: C-0259.00 Sheet 1 of 1
Office: Canberra

Client: QPRC	Date: 21 May 2019
Principal:	By: LC
Project: QPRC HQ	Location: 257 Crawford St, Queanbeyan NSW

Appendix B – Laboratory Test Certificates

Canberra Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
16 Mildura Street
Fyshwick ACT 2609

Phone: +61 2 6124 5660

A TETRA TECH COMPANY

Material Test Report

Report No: ASM:CANB19W00918
Issue No: 1

Client:	D&N Geotechnical Pty Ltd 16 Broadsmith Street Scullin ACT 2614
Principal:	
Project No.:	754-CANB00240AA
Project Name:	Queanbeyan Palarang Council Building
Lot No.:	**TRN:** C-0259

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: Rod Wilkins
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/05/2019

Material Details

Source	Borehole	**Sampled From**	Boreholes
Description	Investigation	**Location**	Queanbeyan, NSW
Specification	AS Grading -19mm	**Sampling Method**	Submitted by client

Sample Details

Sample ID	CANB19S-01625	CANB19S-01626
Field Sample ID	00001	00002
Date Sampled	20/05/2019	21/05/2019
Date Submitted:	21/05/2019	21/05/2019
Sample Location:	BH 02	BH 03
	SPT	SPT
	1.0 - 1.45m	1.0m

Particle Size Distribution

Method:	**Sieve Size**	**% Passing**		**Limits**
AS 1289.3.6.1	19.0mm			
Description:	13.2mm		100	
Determination of the Particle Size Distribution of a Soil - Standard Method of Analysis by	9.5mm		99	
	6.7mm		98	
	4.75mm		98	
Drying by:	2.36mm	100	98	
Oven	1.18mm	99	97	
Washed:	600µm	99	97	
Sample Washed	425µm	99	96	
	300µm	99	94	
	150µm	96	89	
	75µm	81	73	

Other Test Results

Description	**Method**	**Results**		**Limits**
Moisture Content (%)	AS 1289.2.1.1	16.0	6.2	
Sample History	AS 1289.1.1	Oven-dried	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	8.5	N/A	
Mould Length (mm)		254	0	
Liquid Limit (%)	AS 1289.3.1.2	32	30	
Method		One Point	One Point	
Plastic Limit (%)	AS 1289.3.2.1	18	21	
Plasticity Index (%)	AS 1289.3.3.1	14	9	

Comments

N/A

CERTIFICATE OF ANALYSIS

Work Order	: **CA1903412**	Page	: 1 of 2
Client	: **D & N Geotechnical**	Laboratory	: ALS Water Resources Group
Contact	: Mr Dan Butterworth	Contact	: Client Services
Address	: PO BOX 4359 Hawker ACT 2614	Address	: 16B Lithgow Street Fyshwick ACT Australia 2609
Telephone	: 0403 242 404	Telephone	: +61 2 6202 5404
Project	: Soil Samples	Date Samples Received	: 21-May-2019 12:00
Order number	: ----	Date Analysis Commenced	: 29-May-2019
C-O-C number	: ----	Issue Date	: 31-May-2019 12:51
Sampler	: Leandro Souza		
Site	: C-0259.00 - Queanbeyan-Palerang Regional Council HQ		
Quote number	: ----		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 992
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. 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*
Geetha Ramasundara	Chemistry Teamleader	Inorganics, Fyshwick, ACT

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by 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 Contact 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.

- **For samples collected by ALS WRG, sampling was carried out in accordance with Procedure EN67**

Analytical Results

Sub-Matrix: **SOLID** (Matrix: **SOLID**)				Client sample ID	**CB403 2.5m**	**CB401 2.5m**	**----**	**----**	**----**
				Client sampling date / time	20-May-2019 00:00	16-May-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**CA1903412-001**	**CA1903412-002**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
EA002 : pH (Soils)									
ø pH Value	----	0.1	pH Unit		**7.4**	**7.4**	**----**	**----**	**----**
EA010: Conductivity									
ø Electrical Conductivity @ 25°C	----	0.01	dS/m		**0.02**	**0.04**	**----**	**----**	**----**
ED009CA: Anions									
Chloride	16887-00-6	1	mg/kg		**56**	**56**	**----**	**----**	**----**
Sulfate	14808-79-8	2	mg/kg		**70**	**98**	**----**	**----**	**----**