coffey geotechnics
SPECIALISTS MANAGING THE EARTH

PROPOSED CAMERON PARK RESIDENTIAL SUBDIVISION STAGE 54

McCloy Group

GEOTWARA21579AA-AB
12 July 2011

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SPECIALISTS MANAGING THE EARTH

12 July 2011

McCloy Group
PO Box 2214
DANGAR NSW 2309

Attention: James Goode

Dear James

RE: PROPOSED CAMERON PARK RESIDENTIAL SUBDIVISION - STAGE 54
NORTHLAKES DRIVE, CAMERON PARK
GEOTECHNICAL ASSESSMENT

Please find enclosed our report on the above project.

If you have any further questions regarding this matter, please do not hesitate to contact Jason Lee or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd

Arthur Love

Senior Principal Geotechnical Engineer

CONTENTS

1 INTRODUCTION{PRIVATE }

This report presents the results of a geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) on behalf of McCloy Group for the proposed subdivision of Stage 54 which includes the creation of 19 lots. Stage 54 is located on both the north and south sides of Northlake's Drive as indicated on the attached Figure 1. The site is bound by existing or proposed residential development in all directions.

The work was commissioned by James Goode of the McCloy Group in an ATP dated 8 April 2011. A site plan of the proposed development was provided by the McCloy Group.

The scope of work for the geotechnical assessment included providing recommendations on:

- Site preparation;
- Excavation conditions;
- The suitability of the site soils for use as fill an on fill construction procedures;
- Site classification to AS2870 – 2011;
- Special requirements for construction procedures and or site drainage.

The following report presents the results of field investigations and laboratory testing, and provides discussion and recommendations relevant to the above scope of work.

2 FIELD WORK

Fieldwork was carried out on 20 June 2011 and comprised of:

- Excavation of nine boreholes (BH1 to BH9) using a 1.5 tonne rubber tracked mini-excavator to depths of between 0.8m to 0.9m. Undisturbed samples of representative materials were taken for subsequent laboratory testing;
- Observation and mapping of the relevant site features.

All field work was carried out in the full time presence of a Geotechnical Engineer from Coffey who located the boreholes, carried out sampling and testing and produced engineering logs of the test pits. Engineering logs of the test pits are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation.

Boreholes were located by tape measurements relative to existing site features. Approximate borehole locations are shown on Figure 1.

3 SITE CONDITIONS

3.1 Surface Conditions

The site is located on Northlake's Drive with Lots 5401 to 5411 being situated to the north of Northlake's Drive and Lots 5412 to 5419 situated to the south. At the time of investigation some earthworks and road construction had taken place. The majority of the site had been stripped of vegetation prior to the field investigation.

Topographically the site is situated on moderately sloping residual hillsides, with surface slopes typically in the range of 3° to 4° falling towards the south west. At the time of investigation fill was not encountered in any of the boreholes.

3.2 Subsurface Conditions

Reference to the 1:100,000 Newcastle Coalfield Regional Geology Sheet indicates the site to be underlain by the Boolaroo subgroup of the Newcastle Coal Measures, consisting of sandstone, conglomerate, siltstone, coal and tuff.

The typical soils types encountered during the field investigations have been divided into geotechnical units as summarised in Table 1.

TABLE 1 – SUMMARY OF GEOLOGICAL UNITS AND SOIL TYPES

UNIT	SOIL TYPE	DESCRIPTION
1	TOPSOIL / SLOPEWASH	Sandy CLAY; medium to high plasticity, brown becoming grey, fine grained sand, moisture content greater than the plastic limit, firm.
2	RESIDUAL	CLAY; medium to high plasticity, orange becoming orange mottled grey, trace of fine grained sand, moisture content greater than the plastic limit, stiff becoming very stiff.
3	DISTINCTLY WEATHERED ROCK	CLAYSTONE; low to medium strength, orange with some grey, trace of fine grained sand, moisture content less than the plastic limit, hard.

Table 2 contains a summary of the distribution of the above geotechnical units in each borehole location.

TABLE 2 – SUMMARY OF DISTRIBUTION OF GEOLOGICAL UNITS ENCOUNTERED AT TEST PIT LOCATIONS

TESTPIT LOCATION	DEPTH ENCOUNTERED BELOW EXISTING GROUND LEVEL (m)		
	UNIT 1 Topsoil	UNIT 2 Residual	UNIT 3 Distinctly Weathered Rock
BH1	0.0 – 0.2	0.2 – 0.8	0.8 – 1.0 (R)
BH2	0.0 – 0.15	0.15 – 0.9	0.9 – 1.1 (R)
BH3	0.0 – 0.2	0.2 – 0.9	0.9 – 1.1 (R)
BH4	0.0 – 0.2	0.2 – 1.0	1.0 – 1.2 (R)
BH5	0.0 – 0.15	0.15 – 0.7	0.7 – 0.9 (R)
BH6	0.0 – 0.2	0.2 – 1.0	1.0 – 1.2 (R)
BH7	0.0 – 0.15	0.15 – 0.9	0.9 – 1.1 (R)
BH8	0.0 – 0.2	0.2 – 0.8	0.8 – 1.0 (R)
BH9	0.0 – 0.15	0.15 – 0.9	0.9 – 1.1 (R)
Note – (R) denotes practical refusal of 1.5T excavator auger.			

Groundwater inflows were not encountered in any of the boreholes at the time of the field investigations. It should be noted that fluctuations in the groundwater levels can occur as a result of seasonal variations, temperature, rainfall and other similar factors, the influence of which may not have been apparent at the time of investigation.

4 LABORATORY TESTING

Samples obtained during the field investigation were returned to Coffey's NATA registered Newcastle Laboratory for testing. To obtain the information required for site classification the following tests were carried out:

- (5 no.) Shrink / Swell Index to assess clay reactivity;

Results of the laboratory testing are presented in Appendix B and are summarised in Tables 3.

TABLE 3 – SUMMARY OF SHRINK/SWELL TEST RESULTS

TEST LOCATION	SAMPLE DEPTH (m)	MATERIAL TYPE	I_{ss} (%)
BH1	0.2 – 0.4	Sandy CLAY	**1.3**
BH3	0.4 – 0.6	CLAY	**5.8**
BH5	0.2 – 0.4	Sandy CLAY	**1.3**
BH7	0.5 – 0.7	CLAY	**6.0**
BH9	0.3 – 0.5	CLAY	**6.3**

The results indicate that the clay soils are moderately to highly reactive and is typical for clay material in the Cameron Park area.

5 DISCUSSION AND RECOMMENDATIONS

5.1 Site Preparation

Site preparation and earthworks suitable for structure and pavement support should consist of:

- Prior to the placement of any fill, the proposed areas should be stripped to remove all vegetation, topsoil, root affected or other potentially deleterious material. Stripping is generally expected to be required to depths of about 0.15m to 0.2m;
- Site fill beneath structures should be compacted to a minimum density ratio of 95% Standard Compaction within ±2% of 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;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 *'Guidelines for Earthworks for Commercial and Residential Developments'*.

5.2 Excavation Conditions

Where excavation is required, it is anticipated that all site materials could be excavated by conventional dozer blade or backhoe bucket at least to the depths indicated on the appended borehole logs. The depths of topsoil material, depth to rock and levels of mini excavator auger refusal where encountered during field work are summarised in Table 2.

It is expected that rock below the depth of backhoe refusal will be excavatable by ripping to some greater depth although this has not been assessed as part of the current investigation. The use of toothed buckets, ripping tynes, and/or hydraulic rock hammers may be required should hard rock be encountered, particularly in deeper or confined excavations such as for service trenches.

5.3 Suitability of Site Soils as Fill

The following comments are made regarding the suitability of the site materials for reuse in filled areas:

- Where site regrade is proposed, existing fill, topsoil, vegetation or other potentially deleterious material (Unit 1 topsoil/slopewash) should be removed to spoil or stockpiled for reuse as landscaping materials only. Stripping is generally expected to be required to depths of about 0.2m;
- The underlying residual and weathered rock (Unit 2 & 3) should be carefully stripped as necessary and stockpiled for reuse as general site fill;
- Clayey soils on-site are moderately to highly reactive (susceptible to volume changes with variation in moisture content), as indicated by the laboratory testing and will need to be placed and compacted close to the specifications outlined above to minimise reactive soil movements.
- All structural fill needs to meet the parameters and requirements as described in Section 4.3 of AS3798-2007 *'Guidelines for Earthworks for Commercial and Residential Developments'*.

5.4 Site Classification

On the basis of the soil profiles encountered during the field investigations, laboratory testing and preliminary calculations, the site in its current condition is classified in accordance with AS2870-2011 *'Residential Slabs and Footings'*, as **Highly Reactive, Class 'H2'**. A free surface movement in the order of 60 – 75mm has been estimated for the site in its current condition.

The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement. Footings for the proposed development should be designed and constructed in accordance with the requirements of AS2870.

The classification presented above assumes that:

- All footings are founded in controlled fill (if applicable) or in the residual clayey soils or rock below all non-controlled fill, topsoil material and root zones and fill under slab panels meets the requirements of AS2870, in particular, the root zone must be removed prior to the placement of fill materials beneath slabs;
- The performance expectations set out in AS2870 are acceptable;
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, *Foundation Maintenance and Footing Performance: A Homeowner's Guide*, a copy of which is attached;
- Service trenches backfilled with uncontrolled fill do not extend below a line extending out and down at 45° from the ground surface at the edge of buildings;
- The constructional and architectural requirements for reactive clay sites set out in AS2870-1996 *'Residential Slabs and Footings'* are followed.

5.5 Foundation Design Parameters

Based on the proposed development details, footings for the proposed structure are likely to be founded in the residual clay soils (Unit 2) or underlying weathered rock (Unit 3).

Footings may comprise of raft slabs, strip and pad footings, or bored piers / piles. Footings may be proportioned for the maximum allowable bearing pressures as outlined in Table 4 with bored pier design parameters appropriate where piers are founded at a depth equal to or greater than 2 pier diameters and are socketed a minimum of 0.3m in to rock.

TABLE 4 – FOUNDATION DESIGN PARAMETERS

FOUNDING MATERIAL	SHALLOW FOOTINGS	BORED PIER FOOTINGS	
	Allowable Bearing Pressure (kPa)	Allowable End Bearing Pressure (kPa)	Shaft Adhesion (kPa)
Level 1 Controlled Fill (AS3798–2007)	100	-	15
Residual Clay Soils (Unit 2)	150	300	25
Weathered Rock (Unit 3)	300	700	70

The above parameters assume that footings are installed without disturbing the surrounding material.

The settlement of footings proportioned as recommended above should not exceed 1% of maximum footing width or pile diameter.

If cut to fill is performed on the site and shallow footings for the development are proposed, Level 1 controlled fill documentation should be obtained by the designer to ensure specifications in AS2870-2011 *'Residential Slabs and Footings'* are adhered to in the design stage of the project. If this method is opted for, recalculation of the potential free surface movement may be required for the design of shallow footing systems.

6 LIMITATIONS

The extent of testing associated with this assessment is limited to discrete borehole locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

Further advice on the uses and limitations of this report is presented in the attached document, 'Important Information about your Coffey Report'.

For and on behalf of Coffey Geotechnics Pty Ltd

Arthur Love

Senior Principal Geotechnical Engineer