coffey geotechnics
SPECIALISTS MANAGING THE EARTH

GEOTECHNICAL STUDY
PROPOSED CONCEPT DEVELOPMENT
AUSTRALIAN CATHOLIC UNIVERSITY, STRATHFIELD CAMPUS, NSW

Australian Catholic University Ltd

GEOTLCOV24279AA-AF
14 December 2011

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
8/12 Mars Road Lane Cove West NSW 2066 Australia

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SPECIALISTS MANAGING THE EARTH

14 December 2011

Australian Catholic University Ltd
c/- HASSELL
GPO Box 5487
Sydney NSW 2001

Attention: Sarah Waterworth

Dear Sarah

RE: Geotechnical Study

Australian Catholic University - Strathfield Campus Concept Development

Coffey Geotechnics Pty Ltd (Coffey) is pleased to present the results of a geotechnical study undertaken for the proposed Concept Development at the Australian Catholic University, Strathfield, NSW. This report has been prepared to support a development application to the Department of Planning.

For and on behalf of Coffey Geotechnics Pty Ltd

Sven Padina

Associate Geotechnical Engineer

Distribution: Original held by Coffey Geotechnics Pty Ltd

1 electronic copy to HASSELL

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CONTENTS

1 INTRODUCTION

This report presents the results of a geotechnical study carried out by Coffey Geotechnics Pty Ltd (Coffey) for the proposed redevelopment of the Australian Catholic University (ACU) - Strathfield Campus, NSW. The study was commissioned by ACU and was carried out in general accordance with our proposal reference GEOTLCOV24279AA-AA, dated 15 April 2011. This report supercedes our previous report reference GEOTLCOV24279AA-AE, dated 7 September 2011.

Based on the preliminary assessment report and Concept Plan drawings supplied by HASSELL, the proposed redevelopment to cater for future growth will involve the following works:

- Four new development precincts (Precinct 1 to 4) within the campus to provide new library and education buildings;
- New underground parking area in the north west of the Campus and two basement parking areas (beneath Precinct 1 and 3) with a total minimum of 674 spaces;
- Consolidation of main site access and egress into four gates along Barker Road. Staff only access off Edgar Street;
- New access point from Barker Road at the south eastern corner of the campus involving relocating existing traffic signals to form a new intersection with South Street;
- Refined internal circulation within the main Campus providing clear separation between service vehicle access, short term parking spaces, internal bus stop and set-down locations and car parking access;
- Improved site landscaping and public domain including new pedestrian corridors, open space and landscape improvements;
- New pedestrian links throughout the campus to improve internal site linkages to the north eastern campus and preserve opportunities for further consolidation of the campus in the future.

The Illustrative Concept Plan is appended showing the proposed development layout.

The scope of work for this geotechnical assessment comprised a site walkover assessment and a review of existing and available geotechnical information as a basis for the preparation of this preliminary geotechnical study report to support a development application to the Department of Planning.

A Stage 1 contamination study for the project is being carried out by Coffey Environments Pty Ltd and the findings will be presented in a separate report.

2 SITE DESCRIPTION

As shown on Figure 1, the main ACU campus is situated within an established residential area in gently undulating topography. The campus is bounded by Barker Road to the south and St Patricks College to the north. A strip of residential property is situated along the eastern boundary and separates the Edward Clancy building from the main campus.

The northern half of the main campus site consists of grassed playing fields whilst the southern half is presently occupied by numerous buildings ranging from 1 to 3 stories, landscaped areas and asphalt paved carpark areas.

2.1 Site Walkover Assessment

A site walkover assessment was carried out by a geotechnical engineer on Wednesday 8 June 2011 and observations are described below.

Sports Fields

As shown in photograph 1, the grassed sports fields within the western portion of the campus are near level and appear relatively well drained. The southern and western portions of the fields appeared to have been formed in cut whilst the northern portions are natural ground or relatively shallow fill.

Bulk excavation of the sports field is proposed to create an underground carpark.

Photograph 1: Western sports fields with St Patricks College in background

Southwest Carpark

Photograph 2 shows part of the existing carpark located in the southwest corner of the campus where it is proposed to construct the Precinct 3 building and associated basement carparking. The asphalt paved carpark appeared to be in natural ground or relatively shallow fill. Numerous longitudinal cracks and block crack patterns were observed in the pavement. The pavement was graded towards a concrete dish drain located in the western end of the carpark which fed into a stormwater system.

Photograph 2: Part of existing carpark in southwest corner of campus and proposed Precinct 4 in background

Proposed Precinct 4 buildings are proposed to be constructed immediately east of the southwest carpark over a relatively level grassed area presently occupied by a single storey demountable building and a 2 storey brick building.

Southeast Carpark

Photograph 3 shows part of the existing asphalt paved carpark located in the southeast corner of the campus where it is proposed to construct Precinct 1 – library and learning commons buildings. The asphalt carpark appears to have been constructed in predominantly cut and was observed to slope towards the east. The pavement appeared to be in reasonable condition although a few longitudinal cracks were observed. The carpark was surrounded by grass verges and numerous trees. No rock outcrops were observed.

Photograph 3: Part of existing carpark in southeast corner of campus

Block G Buildings

The existing Block G buildings appeared to be located over level, natural ground and were of one and two level brick construction. The exterior of the buildings appeared in good condition. The Illustrative Concept Plan suggests that these buildings are to be demolished and replaced with a new building (Precinct 2).

Photograph 4: Existing Block G Buildings in eastern end of campus

3 PRELIMINARY GEOTECHNICAL MODEL

3.1 Previous Investigations

Coffey has previously carried out geotechnical investigations on the main campus site for the ACU which involved the drilling of 5 boreholes to a maximum depth of 6m:

- 1991 - Drilling of 3 boreholes across the site to provide a preliminary characterisation of site subsoil conditions;
- 1995 – Drilling of 2 boreholes within the footprint of the existing lecture theatre. A four day soaked CBR test was also carried out on a shallow sandy clay sample from the southwest part of the site.

The locations of these boreholes from previous investigations are presented on Figure 1.

The boreholes were drilled to between 4m and 6m depth and encountered silty and sandy clay residual soils overlying fine to medium grained sandstone with some shale layers. Boreholes drilled in the southwest carpark area and the eastern end of the site (near Block G) encountered up to 1m depth of fill.

3.2 Geology

Reference to the Sydney 1:100,000 Geological Sheet indicates that the site lies at the contact between the Bringelly Shale and Ashfield Shale.

Bringelly Shale is the uppermost unit and is described as carbonaceous claystone and laminite with fine to medium grained lithic sandstone. The Ashfield Shale is described as black to dark grey shale and laminite. An intermediate unit, Minchinbury Sandstone, described as fine to medium grained sandstone occurs between the Bringelly and Ashfield Shale units.

Based on the previous boreholes and published geology, fine to medium grained sandstone exists at the site, probably Minchinbury Sandstone.

3.3 Preliminary Geotechnical Model

Based on the existing geotechnical information, site observations and surrounding topography, a preliminary geotechnical model has been developed for the site and is presented in Table 1.

The various units are defined in terms of the appearance, characteristics and, where necessary, rock class based on the classification system presented in Pells *et al* (1998).

Table1: Preliminary Geotechnical Model

Geotechnical Unit	General Description	Estimated Thickness (m) (1)	Estimated Depth to Top of Unit (m) (1)
1 Fill	Typically a mixture of clay, silt, sand with asphalt paving and gravels within existing carpark areas.	0.1 – 1.0	0.0
2 Residual Soil	Typically silty and sandy Clay, medium to high plasticity, very stiff to hard consistency.	0.4 – 1.0	0.1 to 1.0
3a Sandstone (Class V)	Fine to medium grained, extremely weathered, very low strength. (Minchinbury Sandstone?)	0.5 – 2.6	0.5 to 1.4
3b Sandstone and Shale (Class V)	Fine to medium grained, extremely to moderately weathered, low to medium strength with interbedded shale; highly to slightly weathered, low to medium strength. (Minchinbury Sandstone possibly grading into Ashfield Shale?)	Not proven	1.9 to 3.6

Note: (1) The estimated depth and thickness of geotechnical units are based on the available borehole logs and variations are likely to occur across the site.

Groundwater was not encountered in any previous boreholes suggesting that standing groundwater levels are likely to be below 6m depth although fluctuations in the level of groundwater may occur due to variations in rainfall and other factors. A search of the NSW Government Water Information website did not reveal any registered water bores within the immediate site locality.

Perched groundwater may also be encountered within fill, at the soil bedrock interface or within joints and partings within the bedrock.

4 PRELIMINARY DISCUSSION AND RECOMMENDATIONS

The proposed development generally utilises existing vacant spaces within the campus and retains the bulk of existing buildings with the exception of Block G buildings and an existing demountable building situated within proposed Precinct 4. The proposed new Precinct buildings are likely to be up to 3 or 4 storeys.

The proposed underground carpark within the western end of the site will likely require bulk excavations to approximately 4m depth. Similarly excavations of up to 4m depth are envisaged to form a single basement carpark level beneath proposed buildings within the southwest and southeast corners of the site.

The preliminary design advice presented in the following sections is intended to support planning and concept design works. We recommend that comments and recommendations be reviewed and updated to support detailed design.

4.1 Existing Fill

Compaction records of existing fill are unlikely to be available. Therefore, all existing fill should be considered unsuitable to support building loads or new pavement unless excavated and recompacted if suitable, or replaced.

All fill should be compacted to an appropriate engineering specification where required to support building loads or pavements.

Where it is proposed to dispose of existing fill off-site, a waste classification will be required. Movement of surplus soil off-site is governed by NSW legislation and local government conditions that regulate the use of surplus materials, including soil excavated during construction.

4.2 Excavation Conditions and Support

Where excavations are proposed to form carpark basements they would likely encounter fill, residual soils and Unit 3a and possibly Unit 3b Sandstone.

Excavatability

Excavation of the fill, residual soil and Unit 3a sandstone should be able to be achieved using an excavator bucket. Excavations in Unit 3b sandstone and shale would require ripping with a bulldozer or the use of an impact hammer.

Vibrations

The use of hydraulic impact hammers for bulk excavation, trimming sides of excavation and for detailed excavation within Unit 3b would cause vibrations that could damage vibration sensitive structures and services. Once building details are known, vibration assessments should be carried out on susceptible structures.

Cut Batters

For temporary and permanent cuts in soil and weathered rock (Units 1, 2, 3a and 3b), respective batters of 1.5H:1V and 2H:1V should be practicable. The above cut batter recommendations assume that batters are protected against erosion and that surcharge loads are maintain an adequate lateral set-back distance from the crest of excavations.

Retaining

Subject to further investigations, design of retaining walls should be based on a triangular pressure distribution adopting the earth pressure coefficients recommended in Table 2. Coefficients are provided 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 2: Preliminary Earth Pressure Coefficients

Geotechnical Unit	Value of Lateral Earth Pressure Coefficient, K (1)			Passive Earth Pressure Coefficient, K_p (1,2)	Bulk Density (kN/m^3)
	Case 1	Case 2	Case 3		
Unit 1, Unit 2, Unit 3a and Unit 3b	0.3	0.35	0.5	2.5	20

Note:

(1) These values are only applicable for a horizontal ground surface.

(2) Passive earth pressure coefficients for rock have been reduced to allow for potential defects in rock mass.

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 and a trapezoidal earth pressure distribution for propped or anchored retaining walls.

Hydrostatic pressures should be added to earth pressures unless walls can be provided with effective drainage, and surcharge loads such as adjacent footings should also be considered.

4.3 Groundwater

Groundwater may be encountered in excavations and would typically be encountered at the soil/bedrock interface and within joints and bedding planes within the bedrock.

We expect that groundwater inflows into basement excavations would be controlled by pumping from sumps.

4.4 Shrink Swell Assessment

If areas of the site are found to be underlain by fill; they are likely to be classified ‘P’ based on AS2870: 2011. Where natural residual soils form the bearing stratum and are less than 1.8m deep; the sites are likely to be classified ‘M’ based on Table D2 of AS2870:2011.

For detailed design of buildings to be founded on compacted fill or residual soil we recommend assessment of fill depths and the shrink swell characteristics of the fill and residual soils.

4.5 Foundations

Foundations for proposed buildings could comprise raft slabs supported on compacted fill or residual soil, pad footings founded upon hard Unit 2 residual clays or pad footings or piers founding on bedrock.

The preliminary design of edge and internal beams of a raft, strip, pad footings and bored piles founded in sandstone may be designed in accordance with the serviceability design parameters presented in Table 3.

Table 3: Allowable Footing Design Parameters

Founding Material	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Compacted Fill or Unit 2 Residual Soil	300	0
Unit 3a and 3b Class V Sandstone	700	75

To adopt the above parameters, footings should have a minimum embedment of 0.3m into the relevant founding material and bases should be cleaned of debris. Further subsurface investigations would be required if building loads are such that deeper piles are required to penetrate into better quality rock.

The recommended allowable end bearing pressures have adopted a settlement criterion of less than 1% of the least footing dimension.

Shaft adhesion should only be adopted for piles with a minimum embedment of 2 pile diameters into the relevant bearing stratum.

4.6 Carpark Pavements

CBR testing was carried out as part of the 1995 investigation to assess pavement design requirements for the existing carpark situated in the southwest corner of the site. A design CBR of 2% was previously recommended for sandy clay materials and is considered appropriate for preliminary design purposes of pavements founded at or close to existing ground level.

A higher design CBR will be applicable for proposed underground and basement carparks which will likely be founded on Unit 3b Sandstone and Shale.

5 RECOMMENDATIONS FOR FURTHER WORK

Based on the current development concept and the existing geotechnical information we recommend that the following additional subsurface investigation works be carried out to support detail design:

Proposed Underground Carpark

- 4 cored boreholes to a minimum 3m depth below carpark floor level;

Proposed Precinct 1 Buildings – Existing Southeast Carpark

- 4 boreholes drilled to a minimum 6m depth.

Proposed Precinct 2 Building – Existing Block G

- 2 boreholes drilled to a minimum 6m depth.

Proposed Precinct 3 Building – Existing Southwest Carpark

- 2 boreholes drilled to a minimum 6m depth.

Proposed Precinct 4 Buildings

- 2 boreholes drilled to a minimum 6m depth.

General

- Shrink/Swell testing should be carried out to assess classification in accordance with AS2870:2011.
- Laboratory Soaked CBR tests for any new pavements including proposed new access from Edgar Street.

The scope of additional investigations should be reviewed once further details of building loads and excavation depths are established.

6 CONCLUSIONS

Based on the results of this desktop study and our previous experience on similar projects, the proposed development is considered geotechnically feasible and presents a low risk to surrounding structures provided that additional site investigations, design assessments and construction monitoring normally associated with this type of development within the Sydney Metropolitan area are carried out.

7 LIMITATIONS

The preliminary geotechnical assessment and recommendations presented in this report are based on a limited number of boreholes within the campus grounds. Ground conditions can vary over relatively short distances and site specific investigation and construction stage geotechnical assessments should be considered to manage geotechnical risk.

The attached document entitled “Important Information about your Coffey Report” provides additional information on the uses and limitations of this report.

Should you require further information regarding the above proposal please contact the undersigned on 9911 1000.

For and on behalf of Coffey Geotechnics Pty Ltd

Sven Padina

Associate Geotechnical Engineer

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

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

Your report is based on project specific criteria

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

Subsurface conditions can change

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

Interpretation of factual data

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

Your report will only give preliminary recommendations

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

Your report is prepared for specific purposes and persons

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

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

Interpretation by other design professionals

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

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

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

Responsibility

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

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

Figures

drawn	MM / AW	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	AUSTRALIAN CATHOLIC UNIVERSITY
approved	PJW		project:	GEOTECHNICAL DESK STUDY AUSTRALIAN CATHOLIC UNIVERSITY BARKER ROAD, STRATHFIELD, NSW
date	14/12//11		title:	SITE PLAN
scale	AS SHOWN		project no: GEOTLCOV24279AA	figure no: FIGURE 1
original size	A4			

Appendix A

Illustrative Concept Plan

01_ Precinct 1: Library and learning commons
02_ Precinct 2: Eastern
03_ Precinct 3: Western
04_ Precinct 4: Central
05_ New underground car park
06_ New Gate 1 access
07_ New Gate 4 access
08_ New gate access on Edgar Street
09_ Existing sports field to be retained
10_ Edge promenade
11_ Outdoor seating area and bleacher steps to sports fields
12_ New pedestrian only shaded public space
13_ Proposed pedestrian only library commons
14_ Existing service area to be retained and enhanced
15_ University commons to be retained and enhanced
16_ Proposed bus drop off and pick up zone
17_ Upgraded 'green rooms'

ILLUSTRATIVE CONCEPT PLAN

Date
07-December2011

Client
ACU

Project Name
ACU Strathfield Concept plan

HASSELL