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Project 73080
23 July 2012
PMO

Parkview Penrith Pty Ltd
PO Box R1779
ROYAL EXCHANGE NSW 1225

Attention: Ms Amy Romero

Dear Sirs

Report on Preliminary Geotechnical Assessment
Nepean Green – Stage 1: Masters Home Improvement Store
164 Station Street, Penrith

1. Introduction

This report describes the results of a preliminary geotechnical assessment undertaken for a proposed Masters Home Improvement Store which is known as Stage 1 of the Nepean Green development at 164 Station Street, Penrith. The work was undertaken for Parkview Penrith Pty Ltd, developers of the site.

It is understood that the project involves the construction of a large warehouse-type building in the northern portion of the Stage 1 site, with pavements on the northern and western sides of the building for service and delivery vehicles. The southern portion of the Stage 1 site will consist of an on-grade vehicle parking area with access from both Station Street and Jamison Road.

This preliminary geotechnical assessment was undertaken to provide information on the expected subsurface conditions on the site for submission with the Project Application. The preliminary assessment was based on published information, previous experience in the Penrith area and information provided by the client. A site visit by a senior engineer was also undertaken as part of the assessment. Details of the expected subsurface conditions on the site and preliminary comments relevant to design and construction are provided in this report.

2. Site Description

The Nepean Green development site is approximately 8 ha in area and is bounded by a Centro Shopping Centre to the north, Woodriff Street to the east, Jamison Road to the south and Station Street to the west. The Stage 1 site is located in the southern portion of the larger site. A site plan is provided in Drawing MD1 which is attached to this report.

The Stage 1 site is currently vacant and grassed with numerous trees along the northern and western boundaries. The ground surface is relatively flat.

3. Geology and Hydrogeology

The *Penrith 1:100 000 Geological Series Sheet* shows that the site is underlain by Quaternary-aged fluvial soils consisting of gravel, sand, silt and clay. A geological boundary with the Bringelly Shale is shown approximately 500 m to the east of the site.

A search of licensed groundwater bores in the Penrith area found bores for irrigation at Howell Oval to the west of the development site and at Penrith Showground to the north-west. Each of these bores were drilled to depths of about 8 m and encountered standing water at a depth of about 6 m. The wells presumably intersected a gravel layer at this depth with a sufficient groundwater yield to provide water for irrigation purposes.

4. Previous Investigation

Geotechnique Pty Ltd undertook a contamination assessment on the Nepean Green development site, the results of which are given in Report no. 11761/1-AA dated 2 June 2008. This assessment included the drilling of 80 shallow boreholes, 39 of which were on the Stage 1 site. The majority of the boreholes were drilled to depths of 1 m; two boreholes were extended to depths of 6.0 m and 6.3 m. The assessment also included the installation of three groundwater monitoring wells to depths of 10.1 m to 12.0 m on the site to the north of the Stage 1 area.

5. Likely Subsurface Conditions

On the basis of the available information and the previous investigation undertaken on the site by Geotechnique Pty Ltd, the following subsurface profile is considered likely on the Stage 1 site:

- TOPSOIL: Silty clay topsoil with roots and rootlets to depths in the order of 0.1 m to 0.3 m. The presence of filling was not noted in the Geotechnique report but some minor filling is likely to be present.
- NATURAL SOILS: Silty sand, silty sandy clay and silty clay, with some ironstone gravel, below the topsoil and above a river gravel/cobble stratum. The thickness of this layer cannot accurately be determined as the majority of the Geotechnique boreholes were terminated at 1 m depth. Experience elsewhere in the Penrith area suggests that the clayey soils are likely to be of at least stiff consistency and the sandy soils are likely to be loose to medium dense.
- RIVER GRAVEL/COBBLES: River gravel/cobbles were encountered in two locations on the Stage 1 site at depths of 6.0 m and 6.3 m. The three monitoring wells installed to the north of the Stage 1 site encountered gravel/cobbles from depths of 3.7 m to 5.5 m, extending to depths of at least 10 m.
- BEDROCK: Drilling during the installation of one of the monitoring wells encountered bedrock at a depth of 12.0 m, although a description of the rock was not provided in the Geotechnique report. Core drilling would be required to confirm the level and type of bedrock below the site.

- GROUNDWATER: Groundwater levels were measured at depths of 8.0 m to 8.2 m on the site to the north. Wells installed to depths of 6.0 m and 6.3 m on the Stage 1 site were recorded as being dry.

6. Proposed Development

It is understood that the project includes the construction of a large warehouse-type building in the northern portion of the Stage 1 site, with pavements on the northern and western sides of the building for service and delivery vehicles. The southern portion of the Stage 1 site will consist of an on-grade vehicle parking area with access from both Station Street and Jamison Road. Cut-to-fill earthworks required on the site are expected to be minor (i.e. less than 1 m deep).

The geotechnical issues considered relevant to the project include site preparation, excavation, excavation support, groundwater, foundations and pavements. Preliminary comments on these issues are provided in the following sections.

7. Comments

7.1 Site Preparation

Areas on the site that are to be filled to support structures, slabs and pavements should be stripped of filling, vegetation and organic-rich topsoil. The exposed subgrade should be proof-rolled in the presence of an experienced geotechnical professional using a minimum 12 tonne pad-foot or steel smooth drum roller. Any areas on the site exhibiting excessive deflection should be excavated and replaced with suitable granular material compacted in layers. Specific preparation advice can be provided on site once the subgrade has been inspected.

Any filling required on the site should be placed in layers not exceeding a loose thickness of 250 mm, but subject to the equipment proposed, and should be compacted to a dry density ratio of between 98% and 102% relative to Standard compaction. If the filling exhibits clay-like properties it should be prepared within 2% of the Standard optimum moisture content. The clayey soils on the site are expected to be moderately to highly reactive (i.e. equivalent to soils on a Class M or Class H1 site as defined in Australian Standard AS 2870 – 2011 *Residential slabs and footings*).

Based on the information available, the soils excavated on the development site should be suitable for reuse from a geotechnical perspective providing all deleterious materials (e.g. particles greater than 150 mm diameter, organic material, waste etc.) are removed prior to compaction. Any existing filling on the site will need to be stockpiled separately and tested for both geotechnical and contamination requirements to determine its suitability for re-use.

Consideration should be given to placing a 150 mm thick layer of granular material (e.g. recycled crushed concrete or crushed rock) on the subgrade in areas of the site used by construction traffic in order to provide a trafficable surface that will be less prone to disturbance from construction machinery and wet weather.

Australian Standard AS 3798 – 2007 *Guidelines on earthworks for commercial and residential developments* provides guidance as to appropriate testing frequencies for the testing of filling. It is recommended that all filling in areas that will support structures, slabs and pavements be undertaken with Level 1 responsibility.

7.2 Excavation

Excavation is likely to be required for site regrading works, footing construction and for the installation of services. The expected site conditions indicate that excavation will only be required within soils and gravels which should be readily achievable using hydraulic excavators with bucket attachments, scrapers, dozers etc. Excavation in rock will not be necessary and therefore heavy ripping equipment should not be required.

All materials requiring removal from the site will need to be classified in accordance with *Waste Classification Guidelines* (Department of Environment and Climate Change NSW, 2009).

7.3 Excavation Support

Vertical excavations in soils are unlikely to be self-supporting for any significant period of time and will need to be battered or shored to support the adjacent ground. A maximum temporary batter slope of 1(H):1(V) is recommended for cohesive soils on the site and 2(H):1(V) for cohesionless soils. Permanent, vegetated batter slopes should be no steeper than 3(H):1(V).

The design of retaining walls could be undertaken at this preliminary stage using the parameters shown in Table 1. Further investigation will be necessary to confirm the locations and depths of these materials.

Table 1: Preliminary Design Parameters for Retaining Walls

Material	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure Parameter	Bulk Unit Weight (kN/m^3)
Stiff and Very Stiff Clayey Soils	0.3	0.5	100 kPa	20
Loose and Medium Dense Sandy Soils	0.4	0.6	K_p = 2.5	20

Allowance should be made for surcharge loads from structures, sloping ground surfaces, general traffic and construction machinery. Adequate drainage should be provided to prevent the build up of hydrostatic pressure behind the walls.

7.4 Groundwater

Groundwater is expected to in the order of 6 m to 8 m below the ground surface which should not impact upon general site works or the construction of spread footings and pavements. Groundwater may be an issue if piles are used to support the proposed structures and a pile type that is not affected by groundwater should be selected to reduce the risk of complications during construction.

7.5 Foundations

As outlined in Section 8 of this report, detailed investigations will be required to assess founding conditions and footing options. Notwithstanding this, it is anticipated that there will be significant uplift and lateral loads as well as compressive loads on the building footings. Spread footings (e.g. pad and strip footings) could be designed on the basis of a preliminary allowable bearing pressure of 100 kPa in stiff clay soils and loose to medium dense sands, provided that they are founded at least 1 m below the ground surface. Higher allowable bearing pressures, up to say 250 kPa, may be applicable for the site if the strength of the soils is greater than currently estimated.

If the magnitude of the column loads is such that spread footings are impractical, then piles could be used to transfer the column loads to the underlying gravels. Suitable pile types for the site include continuous flight auger (CFA) piles and driven piles (e.g. timber, pre-cast concrete or steel piles). Steel screw piles may also be suitable for light loads (i.e. less than 500 kN).

For CFA piles, a preliminary allowable end-bearing pressure of 1000 kPa could be adopted for the gravels together with a preliminary allowable shaft adhesion of 30 kPa for the overlying soils, provided that the socket is adequately roughened. The top 1.5 m of the pile shaft should be ignored in the shaft adhesion calculations.

Driven piles are usually designed on the basis of a required ‘set’ for a particular pile type and driving rig. It is expected that driven piles would experience practical refusal near the top of the gravel/cobble layer and therefore may not be suitable if the depth to the gravel layer is small. Noise and vibration issues will also need to be addressed if driven piles are being considered for the site.

Steel screw piles could be designed using the allowable bearing pressures provided for spread footings and CFA piles, although shaft adhesion should not be relied upon for support.

Uplift loads could be resisted by assuming 70% of the shaft adhesion values suggested for compressive loads. Lateral load resistance is dependent on the footing type, size and foundation material, and design parameters cannot be provided at this preliminary stage.

Settlement of a pile designed in accordance with this advice may be in the order of 1% of the pile diameter upon application of the design (working) load.

7.6 Pavements

The clayey soils on the site are likely to lose strength upon saturation and for preliminary design purposes a California bearing ratio (CBR) of 3% is suggested for the subgrade materials on the site. This value will require confirmation/refinement during the detailed design phase of the project.

Appropriate cross-fall and subsurface drainage should be installed to reduce the risk of the clayey subgrade becoming saturated during periods of wet weather. Good construction practice, such as installing subsurface drains around the perimeter of any garden or grassed areas, will also help to reduce the chance of subgrade deterioration caused by excessive irrigation.

8. Further Detailed Investigations

The information provided in this report is based on a limited amount of available information and is intended to provide a preliminary overview of expected site conditions only. Site-specific geotechnical investigation will be required to confirm or refine the preliminary design parameters provided in this report. It is recommended that boreholes be drilled in the proposed building footprints, test pits be excavated in the proposed pavement areas, and groundwater monitoring wells be installed prior to the commencement of the detailed design phase of the project. The preliminary information provided in this report must not be used for detailed design purposes.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for the Nepean Green – Stage 1: Masters Home Improvement Store project at 164 Station Street, Penrith in accordance with DP's proposal dated 2 July 2012 and subsequent acceptance received from Parkview Penrith Pty Ltd. The report is provided for the use of Parkview Penrith Pty Ltd for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party.

The comments provided in the report are of a preliminary nature and are based on the results of previous investigations that were not undertaken for geotechnical purposes. Confirmation of assumptions and advice will be required prior to the commencement of the detailed design phase of the project.

Douglas Partners cannot be held responsible for interpretations or conclusions made by others which are not otherwise supported by a statement, interpretation, outcome or conclusion provided in this report. In preparing this report Douglas Partners has necessarily relied upon information provided by the client and/or their agents.

We trust the above information meets your present requirements.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Peter Oitmaa
Senior Associate

G W McIntosh
Principal

Attachments: Drawing MD1
Notes Relating to This Report

N

Nepean Green Development Site

Stage 1: Masters Home Improvement Store

Douglas Partners Geotechnics / Environment / Groundwater	**Location of Site** **Nepean Green** **164 Station Street, Penrith**	PROJECT: 73080 DWG No: MD1 REV: 0
	CLIENT: Parkview Penrith Pty Ltd	DATE: 18-Jul-12

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.