Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Memorandum

To	Henroth Investments Pty Ltd	Dan Maurici	dan@henroth.com.au
From	Scott Easton	**Date**	15 December 2016
Subject	Preliminary Geotechnical Assessment 10-12 Boondah Road, Warriewood	**Project No.**	85749.00.R.001

Introduction

This provides a preliminary geotechnical assessment of the proposed development at 10-12 Boondah Road and 6 Jackson Road, Warriewood. The project is in the preliminary planning stages and specific details have not been confirmed, however it is understood that the development may include;

- a two storey Bulky Goods Centre with undercroft carparking on 10-12 Boondah Road. The undercroft floor level is about RL1.8 m AHD and may require excavation to depths of about 1-2 m below existing surface levels;
- a four storey residential building with a two level basement on the northern end of 10-12 Boondah Road. The basement may require excavation to depths of about 6 m below existing surface levels;
- public open space on 6 Jackson Road with board walks and access to the wetlands.

Geological Mapping

Reference to the 1:100 000 Geological Series Map for Sydney indicates that the site is underlain by Quaternary alluvial and estuarine sediment comprising peaty quartz sand, silt, and clay. The geological map information was confirmed by the field work which identified deep sands interbedded with clay bands and underlain by bedrock at approximately 20 m to 35 m depth.

Published mapping indicates that the site has a high probability of containing acid sulphate soils (ASS) between 1-3 m depth.

Previous Investigations

Douglas Partners Pty Ltd (DP) has carried out groundwater monitoring on the site in December 2016 and prepared a memorandum containing the results dated 5 December 2016 (Project 85749). The groundwater investigation included the drilling of four boreholes to depths of between 4.5 m and 6.0 m with groundwater monitoring wells installed in each borehole. Groundwater levels measured in the wells varied from RL0.8 m to RL1.0 m over most of the site (BH1 to BH3) and RL1.4 m on the slightly elevated northern end part of the site (BH4).

DP has also carried out geotechnical investigations for the Centro Shopping Centre to the south-west of the site. The investigations on that site have included boreholes, deep cone penetration tests and groundwater monitoring.

Geotechnical Model

Based on the limited investigations on the site and our previous investigations in the area it is anticipated that the geotechnical model for the site may include;

- Filling to depths of 1-2m; over
- Very loose to loose sand with clayey bands to depths of 4-8m; over
- Soft to stiff clay to depths of 10-15 m; over
- Dense to very dense sand to depths of 15-20 m; over
- Bedrock at depths of about 20-35 m; and
- A shallow groundwater table at depths of about 1-1.5 m (RL0.7 m to RL1.1 m) over most of the site and rising slightly to about RL1.5 m on the slightly elevated northern end of the site. Groundwater levels will fluctuate and may temporarily rise by at least 1 m (or higher and up to flood levels) following prolonged rainfall. Further monitoring would be required to assess fluctuations in groundwater levels.

Comments

Further detailed geotechnical investigations will be required to assess the soil and groundwater profile on the site prior to detailed design and planning.

From a geotechnical point of view the site is suitable for the proposed development provided that appropriate design and construction is adopted. Further geotechnical review and advice will be required once further detailed investigations are completed and details of the proposed development have been confirmed. Some preliminary comments are provided below.

Excavations for the undercroft to depths of 1-2 m will be close to or below the groundwater table. Excavations for the two level basement to 6 m depth will extend below the groundwater table. Temporary dewatering will be required to temporarily lower the groundwater table to allow for excavation and construction of the basement structures. All below ground structures will need to be tanked and designed for potential elevated groundwater levels, probably to the ground surface (or flood levels).

Dewatering will need to consider potential impacts to surrounding properties and also potential acid sulphate soils. The dewatering may include reinjection of groundwater into the area outside the excavation to help minimise drawdown of groundwater levels and to maintain a more stable groundwater level. The use of impermeable shoring walls extending well below the excavation level may also be used to help reduce groundwater inflows during construction and also to reduce drawdown of water levels outside the excavation. Shoring walls embedded well below the bulk excavation level will most likely be required for the two level basement.

Where the basements are set well back from site boundaries and nearby structures it may be possible to use temporary batters at about 2H :1V (Horizontal:Vertical). Open excavations without shoring will however be associated with higher inflow rates and will almost certainly need to include reinjection to maintain water levels outside the excavation.

Alternatively excavations may be supported by shoring walls. Suitable shoring for excavations below the groundwater table may include;

- a secant pile wall, comprising interlocking Continuous Flight Auger (CFA) piles or CFA piles with jet grouted columns between the piles.
- a soil mixed wall system, constructed using specialised equipment to blend cement with the in-situ soils to create a soil-cement mix. There are several different systems available and further advice should be obtained from the specialist piling contractor regarding the suitability of the wall system to this site.
- sheet piles may be suitable but only where excavations are set well back from adjacent structures due to risks associated with vibration during installation.

Foundations for the new structures will depend on the actual ground conditions, building loads and settlement tolerances. Foundations may include;

- stiffened raft slab;
- piles founded in uniform dense sand or very stiff to hard clay;
- piles founded on rock.

We trust the above satisfies your present requirements. Please contact the undersigned should you have any queries.

Yours faithfully,
Douglas Partners Pty Ltd

Scott Easton
Principal

Reviewed by

Fiona MacGregor
Principal

Attached: About this Report

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.

Copyright

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.