JK Geotechnics
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14 October 2015
Ref No 28650Z Let

Fioson Pty Ltd

Dear Sirs & Madam

HYDROGEOLOGICAL ASSESSMENT
PROPOSED REDEVELOPMENT OF COMPASS CENTRE
THE APPIAN WAY, BANKSTOWN, NSW

This letter presents the results of our hydrogeological assessment of the proposed redevelopment at the above address.

INTRODUCTION

JK Geotechnics have previously undertaken a geotechnical investigation for the above site and the results were presented in our report (ref 28650Zrpt) dated 2 September 2015. We have used the results of the geotechnical investigation, updated where appropriate, to prepare this hydrogeological assessment.

The architectural drawings (Project No 15014, Drawing Nos DA–110–100^{L}, 010^{K}, 020^{F}, 030^{F}, 040^{K}, 050^{D}, 060^{E}, 070^{D}, 080^{D}, 090^{D}, 100^{D}, 110^{K}, 120^{K}, 130^{D}, 140^{D}, 150^{D}, B01^{L}, B02^{L} and B03^{L}) prepared by Turner, indicate that it is proposed to construct a new multi-level commercial and residential building over three levels of basement carparking. The lowest basement level varies between RL12.30m and RL14.00m and will extend to the site boundaries.

The purpose of this assessment was to estimate the inflow rate of groundwater into the basement excavation, and to comment on the required drainage provisions.

SITE DESCRIPTION

The site is located over a gently sloping north-east facing hillside. The site comprises the city block bounded to the north, east, south and west by The Mall, The Appian Way, North Terrace and Fetherstone Street, but excludes the Fetherstone Apartments at 3-7 Fetherstone Street.

At the time of the geotechnical investigation, several single and double storey buildings lined the southern and eastern portions of the site. A three storey library building was located over the north-west, and a multi-storey brick building was located over the mid-west. An asphaltic concrete (AC) carpark was located over the north-east and was connected to Fetherstone Street by a laneway along the southern side of the library building.

The multi-storey residential building, Fetherstone Apartments, was located between the access laneway and the multi-storey building over the mid-west. This building which is not within the development site, appeared to include basement levels, but the depth and extent of the basements could not be determined.

SUBSURFACE CONDITIONS

The 1:100,000 geological map of Penrith indicates that the site is underlain by Bringelly Shales. The investigation has revealed a generalised subsurface profile below the AC, comprising surficial fill over residual silty clay with weathered shale bedrock at relatively shallow depth. For detailed subsurface conditions at specific locations, reference should be made to the attached borehole logs and a summary of the subsurface conditions as encountered, is presented below:

- AC pavements 20mm (BH1 and BH3) and 70mm (BH2) thick were encountered at the borehole surfaces. The AC was underlain by a sandy gravel base to 0.4m (BH1 and BH2) and 0.7m (BH3) depth.
- Fill comprising silty clay of high plasticity was encountered below the pavements and extended to depths between 0.6m (BH2) and 1.2m (BH3).
- Residual silty clay of high plasticity was encountered below the fill. The silty clay was of variable strength between stiff and hard.
- Weathered shale bedrock was encountered at depths of 4.4m in all boreholes. On first contact, the shale was of very low to low strength and improved with depth to low to medium strength and better.
- The following classifications for the shale bedrock, in accordance with Pells *et al* (1998), apply:

Location	Depth to Surface of Rock Class			
	Class V (m)	Class IV (m)	Class III (m)	Class II (m)
BH1	4.4 – 5.1	5.1 – 6.6	–	6.6 – 10.84
BH2	4.4 – 4.8	–	–	4.8 – 10.52
BH3	4.4 – 5.0	8.4 – 10.7	–	5.0 – 8.4

- Groundwater was not encountered whilst auger drilling the boreholes. On completion of core drilling BH2, the groundwater was measured at a depth of 1.35m. We note that water is added to the boreholes to facilitate coring, and this masks any natural groundwater seepage. However, the estimated full recycled flush water return indicates a relatively impermeable rock mass. On our return to site approximately 10 days and 31 days following completion of drilling, the groundwater level in BH2 was measured at a depth of 2.49m and 2.70m, respectively.

PERMEABILITY DETERMINATION AND SEEPAGE ANALYSES

The groundwater level in the previously installed standpipe was remeasured on 24 August 2015, and then a pump-out test was carried out. The pump-out test involved pumping out the groundwater in the standpipe and then measuring the rate of recovery. Using established seepage formulae, the mass permeability of the rock was determined.

The mass permeability value obtained from the pump-out test results was $1x10^{-7}$m/sec which compares well with the log mean value presented by Pells (2004) for Class III shale. The groundwater level was measured at 2.7m (ie. RL19.4m).

The above mass permeability value was then used with a geotechnical model established from the geotechnical investigation, in a finite element analysis (SEEP/W) to estimate the likely rate of groundwater inflow into the bulk excavation. A total inflow rate of about 3ML/year was indicated by the analysis.

COMMENTS AND RECOMMENDATIONS

Based on our experience in the area, we anticipate that the natural regional groundwater level is well below the proposed bulk excavation level. The encountered groundwater is considered to be associated with transient or perched groundwater flowing through bed partings and joints in the rock mass. As such, we consider that the groundwater infiltration rate predicted from our analyses to be conservative and an upper bound value.

The above has been confirmed by recent observations made in an excavation at one of our projects at 61-63 Rickard Road, approximately 200m to the north-east. Seepage into the approximately 10m deep excavation was observed to be of extremely low volume and occurred as localised seepage from one location only.

Given the above, we consider that seepage volumes into the excavation will be controllable by conventional sump and pump dewatering systems during construction and over the long term. The groundwater flows would be able to drain through drainage provisions behind the retention system and the underfloor drainage below the basement floor slabs. The piped drains would be graded to sumps for automatic pump discharge of collected seepage to the stormwater system.

However, a more accurate assessment of likely seepage and required pumping capacity would best be made during and following completion of the bulk excavation, when seepage can be observed. We therefore recommend that groundwater seepage into the excavation be monitored by site personnel and the geotechnical engineer, to confirm that seepage volumes are within the range anticipated.

Given the transient or perched nature of the groundwater, we do not expect that the proposed drainage will result in a drawdown to the extent that surrounding buildings will settle. Also, being in a built-up business district, there are no groundwater users who would be affected.

CONCLUSIONS

1 We anticipate that the regional natural groundwater level is well below the proposed bulk excavation level.

2 However, localised groundwater seepage of limited volume into the excavation can be expected from joints and bed partings within the shale rock mass. The groundwater inflow rate is expected to be less than $1x10^{-7}$m/sec and is considered to be associated with transient or perched groundwater.

3 We anticipate that the localised groundwater seepage volumes will be controllable using conventional sump pump drainage systems.

4 Given all of the above, the expected low permeability of the soil and bedrock profile, and the relatively large plan area of the site, we consider that construction of a drained basement would be feasible and appropriate.

Should you require any further information regarding the above, please do not hesitate to contact the undersigned.

Yours faithfully
For and on behalf of
JK GEOTECHNICS

A ZENON
Principal Geotechnical Engineer.

Encl: Figure 1: Site Locality Plan.

Ref: 28650Z Figure 1

Image sourced from *Google Maps*

Site Locality Plan

To be read in conjunction with text of report.

28650Z • FIGURE 1