Pells Sullivan Meynink
Engineering Consultants
Rock-Soil-Water

G3 56 Delhi Road
North Ryde NSW 2113
P: 61-2 9812 5000
F: 61-2 9812 5001
mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM2124-008L
Date: 31 October 2013

South Village Pty Ltd
c/o Ionic Management Pty Ltd
Shop 1, 22 Gadigal Avenue
ZETLAND NSW 2017

ATTENTION: CHRIS RYAN
By email: cryan@imanage.net.au

Dear Chris,

RE: KIRRAWEE BRICK PIT
GEOTECHNICAL AND GROUNDWATER ASSESSMENT

1. INTRODUCTION

At the request of Chris Ryan of Ionic Management, PSM has reviewed the documents provided as listed in Section 2 and undertaken an assessment of the geotechnical and groundwater issues for the proposed development at the Kirrawee Brick Pit.

2. DOCUMENTS PROVIDED

We have been provided with the following documents listed in chronological order of the documents:

1. URS "Final Report, Geotechnical Assessment for Former Kirrawee Brick Pit", Ref. 19892-024, dated 8 April 2003.
2. URS "Report: Geotechnical Slope Risk Assessment along Flora Street Boundary", Ref. 43167325, dated 10 April 2006.
3. AWT survey drawing "Plan showing boundaries, areas and volumes of Kirrawee Brick Pit", Ref. 060811 RevB, dated 22 September 2006.
4. URS "Report, Supplementary Geotechnical Investigations, Former Kirrawee Brick Pit", Ref. 43167393, dated 20 November 2006.
5. Patterson Britton "Kirrawee Brick Pit Servicing and De-watering Preliminary Investigation", Ref. rp6669cjm061124 rev3, dated 5 December 2006.

6. URS "Design Report: Design of Stabilisation Works along Section S6 at Flora Street Boundary", Ref. 43167449, dated 30 January 2007.
7. Jeffery and Katauskas (J&K) "Report on Geotechnical Assessment for Proposed Mixed Use Development at Kirrawee Brick Pit Site", Ref. 21714SLrpt4rev1, dated October 2010.
8. C.M. Jewell & Associates "Groundwater Assessment" Ref. J1418.13R-rev0, dated October 2010.
9. C.M. Jewell & Associates "Dewatering Plan" Ref. J1418.10R-rev0, dated October 2010.
10. C.M. Jewell & Associates "Hydrogeological Data Report" Ref. J1418.9R-rev0, dated October 2010.
11. C.M. Jewell & Associates "Long-Term Groundwater Management Plan" Ref. J1418.11R-rev0, dated October 2010.
12. Northrop letter "Response to Drainage and Stormwater Management Matters", Ref. 10641, dated 12 November 2010.
13. Woodhead architectural drawings, approved by NSW Government, Department of Planning, 23 August 2012.
14. Northrop drawings "Construction Methodology", Sheets 1 to 3, Ref. SK10 to SK12 rev3, dated 27 May 2013.

3. SITE INSPECTIONS

Site inspections were undertaken by PSM together with Ionic on 20 June 2013 and 5 September 2013 in which a general site walkover was completed and a general inspection at the top of the southern batter was undertaken.

Further, an inspection of the southern batter was undertaken by PSM by boat on 3 and 4 July 2013 while undertaking a sediment assessment (Ref. PSM2124-006L, dated 9 July 2013).

4. ASSESSEMENT

We have reviewed the above listed documents. Based on the review and our site inspections, we have undertaken an assessment of the geotechnical and groundwater issues that should be considered.

4.1. Batters

4.1.1. Existing batters - Instability during dewatering (particularly the Southern Batter)

We agree with J&K that there is a risk of instability of the existing batters during dewatering of the pit. The consequence of instability on the north, east and west batters are small as the instability is likely to be contained within the site boundaries. Any instability of the southern batter could potentially impact on Flora Street and therefore would have a more significant consequence.

URS has undertaken a risk assessment of the southern batter and reported this in the April 2006 URS Report. The batter condition of the southern batter above the water line comprising of residual soil overlying shale has largely been the same since the URS assessment in that no significant failure has occurred since 2006. This was confirmed during an inspection by boat of the southern batter face undertaken by PSM.

On the above basis, we consider that there is no real benefit in reshaping the top of the southern batters. We expect any failures that occur in the upper batters are likely to be small (eg overhanging blocks and wedges above the water line) with a small potential of affecting a portion of the existing carpark along Flora Street.

Our current assessment is that temporary support is unlikely to be required for the upper batters. However, if required, it is likely to comprise a soil nail, mesh and shotcrete type solution.

J&K has suggested an approach of pushing fill into the pit up against the southern batter prior to dewatering. We consider that this approach is not practical and is unlikely to reduce the likelihood of instability.

The simplest control of such potential instability will be to control the rate of water drawdown, we expect that this will be possible within the project schedule. Geotechnical monitoring of the batters during drawdown will be required. A detailed monitoring plan should be prepared prior to any works. This is discussed in Section 5.

Should instability be observed during dewatering, possible solutions might involve designing a bund to control the instability or some form of temporary support comprising mesh, shotcrete and anchors to support areas of instability.

4.1.2. Existing batters - Instability during works within pit

The risk to workers and equipment within the pit after dewatering from instability of the batters is similar to that usually present for work during basement excavations.

The risk will need to be controlled by means of minor scaling, exclusion areas near batters, bunding, safe work practices, regular inspections, etc. These are generally matters within the responsibility of the contractor / builder.

4.1.3. Existing batters - Instability during excavation of existing batters

Based on the current proposed development, most of the southern, northern and eastern batters will require excavation or trimming to achieve the final basement shape. When undertaking this work the following risk control measures should be considered to control the risk of instability:

- The basement should be positioned to minimise trimming and excavation of faces where possible particularly where the batters are located adjacent to the site boundary, e.g. the southern batter.
- Permanent retention is likely to be required particularly for any fill and residual soils and potentially some weathered shale. This is discussed in Section 4.1.4.

- Excavation should be undertaken where practical from the top down. On the northern and eastern batters there is enough room to allow the excavation to occur from behind the crest. For the southern batter it may be necessary to build a temporary embankment in front of the batters (ie within the pit) to allow access to the top of the batter for excavation.
- For the rock faces, as a new face is exposed, this should be inspected by a suitably qualified engineer at regular intervals and localised support be installed where necessary (eg anchors, mesh and shotcrete etc.). We note that should temporary / permanent anchors be required for the southern batter, these may need to extend outside the site boundaries below Flora Street. This may generate permit issues with the road owner.
- A safe work method should be developed by the contractor.

4.1.4. New and existing batters - Long term stability

For permanent batters (new and existing), the recommendations provided by J&K regarding permanent batter angles, and permanent support are considered typical and assessed to be reasonable.

Permanent retention for the soils and weathered shale might comprise shoring piles, mesh and shotcrete with anchors. The shoring piles should be installed prior to excavation and anchors installed as excavation progress. Anchor installation might need to be undertaken by excavation of slots prior to the main excavation. As for the excavation, it may be necessary to build a temporary embankment in front of the batter (ie within the pit) to allow access to the top of the batter for anchor installation. Installation from the crest with a long reach excavator might also be possible.

We consider that installing shoring piles without anchors (ie cantilevered) prior to dewatering does not provide any short term retention.

4.2. Foundations

Given the likely column loads, and the building geometry, all the structures are likely to be founded on bedrock with the exception of the basement ground slabs which may be required to be constructed on structural fill.

With regards to pile foundations we consider that:

- Pile construction can be difficult through fill particularly historical fill where buried objects may be present. Where piles are used within fill, negative skin friction should be considered in the design.
- Founding of piles through fill and on the steep buried batters is also difficult and should be avoided where possible. A potential for this scenario is shown on Section 2 of the Woodhead drawing 0301 where the building is shown to be built over fill against the south batter. We recommend that a good survey of the batter (southern batter in particular) be undertaken prior to it being buried and where possible piles shifted accordingly.
- Where footings or piles are founded near the crest of a batter the bearing capacity should be reduced accordingly.

4.3. Drainage

We do not expect that there will be high groundwater seepage into the pit and broadly agree with the assessments made by J&K and CM Jewell.

We agree with J&K that the expected seepage would be able to be controlled by conventional sump and pump systems.

A gravel drainage blanket may be required below the basement slabs as part of the sump and pump system.

However, we consider that the drainage gravel blanket suggested by J&K and extending over the entire base of the pit is not necessary. A significantly simpler drainage system comprising of a few gravel trenches located at the low points and draining to the sumps is all that is likely to be required.

4.4. Filling

Materials that would be generated from the development include Virgin Excavated Natural Materials (VENM), existing site won fill and softened / wet material at the base of the brick pit (sediment).

We expect that the VENM and existing fill to be geotechnically suitable for re-use as a structural fill. For the sediments at the base of the brick pit, contrary to the recommendation by J&K to dispose of this material, we expect that the majority of this material can be reused as non-structural / structural fill (eg under the water feature at the western side of the development) provided it is given time to dry and possibly mixed / blended with some of the VENM material. This has been done on similar developments.

Maximum reuse of excavated material on site should be considered, off-site disposal of non-VENM to landfill will have negative environmental impacts.

The specification for the structural fill and the fill below the lake can be simplified to result in maximum reuse of material and minimum handling, moisture conditioning etc. For example, at depth the requirements for moisture control and maximum compaction may be able to be reduced or removed completely.

On some projects, we have developed specifications for use of bricks blended with VENM as structural fill.

5. GEOTECHNICAL MONITORING DURING DEWATERING

We understand that the dewatering is proposed to be undertaken over a 2 to 3 month period. Prior to any works (including dewatering), a geotechnical monitoring plan should be prepared. We recommend the following monitoring as a minimum:

1. Array of survey prisms at the crest of the southern batter at 10 m centres.
2. Array of survey pins (or similar) at 10 m centres along the carpark kerb on Flora Street. This is approximately between 3 m to 10 m offset from the crest.

3. Vibrating wire piezometers (VWP) at 50 m centres along the southern batter to monitor changes in pore water pressures within the batter. This would involve drilling a borehole and grouting in the VWP.
4. Geotechnical walkover inspection every fortnightly.

The monitoring plan should include the following details as a minimum:

1. Instrument specifications and installation locations
2. Baseline reading requirements
3. Trigger levels and action plan
4. Monitoring frequency
5. Potential contingencies
6. Key personnel and roles and responsibilities

We consider that the above approach will sufficiently control the risk of potential instability of the existing batters (particularly the southern batter).

Should there be any queries, do not hesitate to contact the undersigned.

For and on behalf of
PELLS SULLIVAN MEYNINK

GARRY MOSTYN
Principal

BERNARD SHEN
Associate