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geotechnical engineering consultants

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3258-R1
1 September 2015

The Hills Shire Council
3 Columbia Court
Baulkham Hills NSW 2153

Attention: Mr Brent Woodhams

Dear Sir,

PROPOSED RESIDENTIAL SUBDIVISION, NO. 39-55 ORATAVA AVENUE AND PART OF NO. 570 PENNANT HILLS RD, WEST PENNANT HILLS
GEOTECHNICAL PEER REVIEW

It is understood that Kai Ling (Australia) Pty Ltd (KLA) has lodged a Planning Proposal with The Hills Shire Council (HSC), reference Planning Proposal 18/2015/PLP. Part of the land that is included in the Planning Proposal is identified as being subject to landslide risk as identified in the HSC LEP 2012.

Geotechnical studies have been undertaken by Davies Geotechnical Pty Ltd (Davies), particularly focusing on landslide risk.

Three geotechnical reviewers from Council's panel of geotechnical consultants were appointed by KLA, to review the supplied geotechnical reports and the current site conditions, and to prepare a joint report on the findings of the panel with respect to the adequacy of the geotechnical reports and the suitability of the land for residential development as proposed in the Planning Proposal. The panel review members are Rolf Rohleder of Aurecon Australasia Pty Ltd, Mark Delaney of Newcastle Geotechnics, and Mark Bartel of Asset Geotechnical Engineering Pty Ltd.

A review closeout spreadsheet was developed by the Panel, covering the geotechnical aspects relating to the Planning Proposal. A copy of this spreadsheet is attached.

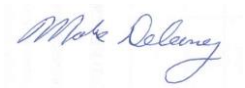
In summary, the Panel considers that the geotechnical studies undertaken to date adequately demonstrate that the proposed subdivision as outlined in the Planning Proposal is geotechnically feasible with respect to landslide risk issues. The Panel recommends that Council impose a number of Consent Conditions, as described in Items B1 to B7 in the attached spreadsheet.

It is also noted that Rolf Rohleder no longer works for Aurecon and therefore is unable to sign this cover letter. However, Rolf had completed his review and provided his review comments for incorporation in the closeout spreadsheet whilst he was still employed with Aurecon. Considering that the Panel reviewers did not identify any geotechnical issues requiring further response from the proponents and subsequent further assessment, the remaining two Panel reviewers do not consider that engaging a third panel review member at this point is warranted or necessary.

For and on behalf of
Asset Geotechnical Engineering Pty Ltd

Mark Bartel
BE MEngSc GMQ RPEQ MIEAust CPEng NPER (Civil)
Managing Director / Senior Principal Geotechnical Engineer

For and on behalf of Newcastle Geotech Pty Ltd



Mark Delaney
Principal Engineering Geologist

Encl: Closeout Spreadsheet

cc: Kai Ling (Australia) Pty Ltd
20 Gymkhana Place
Glenwood NSW 2768

Geotechnical Peer Review Closeouts - Planning Proposal 18/2015/PLP

Project: NO. 39-55 ORATAVA AVENUE AND PART OF NO. 570 PENNANT HILLS RD
Revision: 2
Date of issue: 1/09/2015
Reviewers: ROLF ROHLEDER (AURECON AUSTRALASIA PTY LTD); MARK DELANEY (NEWCASTLE GEOTECH); MARK BARTEL (ASSET GEOTECHNICAL)

Item	Document Title or Issue	Reference	Comment Date	Peer Review Comment	Responder's Name	Response/Action for Resolution	Date	Closed?
A1	Adequacy of Investigations carried out		31/08/2015	The report contains results and discussion of 3 site investigations undertaken in 1997, 2001 and 2015. The 1997 investigation comprised 16 Test Pits located across most of ex. Lot 8, with a single Test Pit (TP16) in ex. Lot 9. The 2001 investigation comprised 6 no. boreholes (advanced by auger method) across the south portion of ex. Lot 8 only, to between 4.8m and 9.1m depth. Standpipe piezometers were installed in all six BHs, with monitoring continuing for about 18 months thereafter. The 2015 investigation comprised 5 no. boreholes (advanced by auger in soils with rotary core follow-on in the shale bedrock), also across the south portion of ex. Lot 8. These were advanced to between 10m and 12m depth, with standpipe piezometers installed in 2 of these, and slope inclinometers in 3 of these. It is noted that BH7-9 were cored from a shallow depth (<1.6m) to provide a cored profile of the slide material. In our opinion, the above investigations have provided very good coverage across Lot 8, and the ground information obtained from these investigations, together with the associated instrumentation type and monitoring, is more than adequate to formulate a reliable ground model of the area in question, and the mechanism involved in the identified landslide activity. A Contamination Assessment report (by Network Geotechnics, dated 24/7/2015) for ex. Lot 3 (570 Pennant Hills Rd) was also made available to the Panel. The report contains the logs of 8 no. test pits dug across Lot 3. Although these were undertaken for Environmental purposes, and not for geotechnical assessment, they do provide a basic ground profile across the site to the depth investigated (max. 1.5m). The results confirm that the site area covered by the test pits is essentially a filled platform, with fill depth somewhat variable (generally < 0.5m thick) over residual gravelly clay soil. No groundwater was intercepted in any of the pits. Shale bedrock was encountered at 0.9m depth in one Test Pit. The ground conditions are considered typical of what would be expected in a shale area. The information gained from this investigation is considered sufficient for the purpose of Rezoning Application. However, as indicated in the Davies Geotechnical report, a recommendation is made for additional soil sampling / testing at detailed design, including Lot 3 area, that will inform the Site Classification in terms of AS2870 as well as design of foundations for buildings. **On the basis of comments above, we consider that a more than adequate level of ground investigation has been undertaken for the proposed development site that serves to inform the ground conditions and geotechnical constraints associated with the proposed development.** **We note that the level of investigation and analysis undertaken is more detailed than is generally required for a rezoning application. The level of detail in this regard has demonstrated that a smaller lot / higher density development on the site is geotechnically feasible and that practical subsoil drainage measures can be installed to control groundwater levels and maintain a long term acceptable factor of safety.**				Y

A2	Adequacy of Interpretations presented in the report		31/08/2015	Warwick Davies is an experienced and reputable geotechnical practitioner with a thorough understanding of the geotechnical setting in the Sydney region, and has been an active member of the Australian Geomechanics Society workshops involved in development of the AGS Landslide Risk Assessment Guidelines. Warwick also has extensive experience in the landslip area of Castle Hill and West Pennant Hill and has specific site knowledge at 39 Oratava Ave dating back to 1997. Based on the ground investigation information obtained from the site, the report presents a ground model of the site, with cross-sections, and inferred soil/rock stratigraphy using identified soil/rock units with similar characteristics. The report has also relied on external documented and published information on landslide occurrence in the area, that supports the landslide model and mechanisms invoked for the site. The report provides detailed slope stability analysis for the existing slope at a number of sections and incorporates sensitivity analysis and modelling based on variable groundwater levels. The significant rainfall event in April 2015 and the minor creep movement recorded in the inclinometers has facitated back analysis of the slide and a high level of confidence in derived parameters use to model the proposed subsoil drainage remedial measures. Significantly, the report has relied on fairly detailed geotechnical instrumentation monitoring, correlated to rainfall data, which is used to explain and justify the mechanisms for the identifed landslide hazard. Inclinometer data, in particular, is generally considered high-level, sophisticated instrumentation which is typically employed on larger projects where slope stability is a critical concern. **On the basis of comments above, we consider that the ground models and interpretations of the ground conditions presented in the report are reasonable and justified by the findings of the various investigations and the recorded monitoring data.**				Y

A3	Adequacy of Recommendations presented in the report (also refer to Specific Comments / Recommendations in table below)			**Mitigation Measures for Landslide Risk Minimisation:** The report recognizes and emphasizes that major subsoil drainage across most of Zone G4 (refer to Fig. 7 of report) will be key to minimising the risk of ongoing creep movement in the landslide area. This measure is generally in accordance with accepted practice for mitigation of landslides in the Wianamatta Shales in the region, and reference has been made to a well-know geotechnical paper by R. Fells (2006) that puts forward drainage recommendations for this type of landslip mass movement. Long term maintenance of the drainage system will be facilitated by the proposed community title. Appendix G , section G2 sets out a recommended maintenance and inspection programme for the drainage lines and pits. It is assumed that detailed design will incorporate flushing capacity for the subsoil lines. **Recommendations for Earthworks**: The report recommends that earthworks be assessed at detailed design, and that a geotechnical review be undertaken of design excavation depths, batter slopes, retaining structures, and earthfill materials employed. This is consistent with good engineering practice. The occurrence of uncontrolled fills in parts of the site (Zones G5 and G4) have been identified and to some extent mapped. Recommendations are made for further assessment of distribution and contamination assessment of fills, which is in line with Environmental guidelines (eg. Waste Classification). Details in relation to treatment of the uncontrolled filling to be provided in detail design. **Recommendations for Building Foundations:** The report provides general recommendations for building foundations, although these should be determined on a Lot by Lot basis at detailed design. In Zones G4 and G5, deeper foundations systems (pier, piles) are suggested, together with an options for stiffened raft foundation. These are generally sound recommendations for foundation design, although possibly somewhat on the conservative side. The detailed design of foundations in zones G4 and G5 will be contingent on the treatment methodology adopted for the existing fill and the level of earthworks control. **Risk Assessments (Table 8):** A risk assessment table (based on AGS Guidelines) is presented in Table 8 of the report in relation to the identified Landslide Hazards (different modes of failure), with overall risk rating for both existing conditions and with recommended ground improvement measures. The method use to determine the likelihood and consequence factors, as well as the assessed risk level, are in accordance with the generally accepted AGS Guidelines. **On the basis of comments above, we consider that the conclusions and recommendations provided in the report, with regards the proposed developments, are reasonable and in accordance with sound engineering practice. The recommendations also generally follow the recommended mitigation measures that are generally accepted and employed in landslide-affected areas in the Wianamatta Shale areas in the region.**				Y
A4	Satisfactory Site Inspection by Peer Reviewers		31/08/2015	We confirm having inspected the site (walkover inspection) on Thursday 13 August 2015, with Wawick Davies of Davies Geotechnical. Representatives of the developer were also presented. We were able to walk across all areas of the site, and inspect some of the borehole and test pit locations, inspect the exposed shale areas in the steep slope (Zone G4/G5). During the walkover, Warwick Davies explained and pointed out key features of the site pertaining to the landslide area and other relevant factors.				Y

B1	Gap in ground investigation information (existing Lot 3)			As indicated in A1 above, some information on expected ground profile across this Lot has been made available (Contamination Assessment report). However, it is recommended that additional soil sampling and testing be undertaken at detailed design (possibly with confirmation of depth to shale bedrock), in order to inform the design of the proposed building foundations. **Consent conditions to include this requirement.**				Y
B2	Monitoring of installed instrumentation			Although the recent piezometer monitoring was undertaken in April and May this year, it would be helpful to obtain a longer record of groundwater levels up to time of construction, if possible. Likewise, 2 of the 3 inclinometers detected nominal movement (at about 6m depth) over a period of 2 months. Inclinometers are precise instruments and it would be useful to continue obtaining readings from them that would help to gain a better picture of the rate of landslip movement and how rainfall /elevated piezometric head is a triggering mechanism. We therefore recommend that monitoring of the installed piezometer and inclinometer instrumentation continue, with dataloggers maintained in the piezometers (the recording interval can be increased to provide longer term monitoring capacity) and that inclinometer monitoring be undertaken on a nominal timeframe and in response to a significant rainfall event (say > 50mm in one day and 150mm total in a week). Monitoring should continue at least until commencement of earthworks on site. **Consent conditions to include this requirement.**				Y
B3	Additional ground investigation			At this stage, for the purpose of the Re-Zoning Application, we consider that the ground investigations undertaken to date are adequate. However, we agree with the recommendations in the report that additional ground investigation, particularly with regards soil sampling and laboratory testing (geotechnical classification tests, contamination testing), be undertaken at detailed design stage to support the design of earthworks, particularly compaction requirements for soil re-use as engineered fill and subgrade design for pavements (access roads). **Consent conditions to include this requirement.**				Y
B4	Sydney Water Mains (Lot 8)			If possible, a Condition Assessment of the existing water main (we understand this is a 450mm diameter pipe) should be sought from Sydney Water. This should be carried out in advance of the development to facilitate repair work in the case it is leaking and to allow drying out of wet ground conditions that may may be associated with this. It is possible that this pipe may be leaking and contributing to the excess soil moisture noted in the soils in the south portion of Lot 8 (near the centre). We understand this pipe will be relocated during the development. Consideration should be given to examining the condition of the pipe when it is removed, and to reinstatement of the ground above the pipe. **Consent conditions to include this requirement.**				Y
B5	Proposed Lots 8-11 at east end of Lot 8 (south part)			The western boundary of these Lots, as indicated in the concept drawings, may encroach onto the steep Shale slope in this area. Care will need to be taken during detailed design with regards to cutting into this slope. Any proposed cutting should be properly investigated by a geotechnical specialist to establish that the stability of the cut slope will not be detrimentally affected. Any excavations into this slope will need to be fully supported by engineered retaining walls installed during the subdivision earthworks stage with appropriate controls (88B instument or similar) adopted to limit future excavation or filling on these steep slopes by individual landowners. **Consent conditions to include this requirement.**				Y

B6	Drainage Design/Hydrology			As outlined in the report, adequate and effective drainage design will be critical to the development of the site, so as to reduce as much as practical, possible risks associated with landslip movements. Slope stability analysis indicates that an acceptable factor of safety is achieved where subsoil drainage maintains a maximum groundwater level of 2m below the surface. Preliminary subsoil drainage is based on a minimum trench drain depth of 3m with additional redundancy provided by chimney drains to 6m depth to provide relief of any excess hydrostatic pore pressure. The preliminary subsoil drainage design and layout is considered to be an appropriate long term drainage solution with further refinement to be provided in detailed design. The eventual detailed drainage designs will need to be assessed by a hydrologist who can verify the design assumptions, particularly with regards to groundwater flows and capacity of drains, as well as discharge points. The use of flexible buried pipes for services is also strongly recommended. **Consent conditions to include this requirement.**				Y
B7	Geotechnical Supervision during Works			It is strongly recommended that critical stages of the development be inspected and verified by a competent, geotechnical engineer. This includes any new cuttings, excavations (generally deeper than 1.5m), installation of subsoil drains, pier or piled foundations, and construction of earthfill platforms. **Consent conditions to include this requirement.**				Y