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Dr Sergio Sepulveda
Profesor Asistente
Departamento de Geología
Universidad de Chile
Plaza Ercilla 803, Santiago

Ref:
19 January 2012

Dear Dr Sepulveda

Regarding: "ESTUDIO DE RIESGO Y ADECUACION PLAN REGULADOR COMUNAL SAN JOSE DE MAIPO"

Thank you for sending the report and appendices for the above project to me for review. I have looked carefully at the data and the analyses that you have performed upon it.

First, I can confirm that the work has been undertaken in accordance with the required international standards. The data collection has been appropriate and has been undertaken with care and rigor, and all of the required information is included. The methods of analyses, both in terms of the interpretation of the landslide itself and the stability of the slopes, is appropriate. Thus, my strong sense is that the conclusions drawn are appropriate and reasonable.

The results suggest that the likelihood of a large, deep-seated landslide triggered by a large but credible landslide is acceptably low. The calculated Factor of Safety is larger than would be required in a design code for a constructed slope, and thus must be considered to be tolerable. The major issue with the main slope is that it may be susceptible to a progressive type of failure, which could in time lead to a non-seismic slip or to an increased potential for a seismically-induced failure. Fortunately, in both cases there is likely to be clearly identifiable indications that such a progressive mechanism is continuing to operate. Given that the slope has clearly evolved during previous periods of inclement weather, this possibility is unacceptably high. I would strongly commend and support the recommendation that medium term monitoring and analysis of the slope is undertaken to determine the nature of this process. Monitoring can be relatively infrequent, but should be increased when there is a prolonged period of heavy rainfall, or after a large earthquake, or if increased rates of movement are detected. I would also recommend revisiting the data in two years; at that time it should be possible to determine if the continued monitoring is required. If the slope is showing little sign of activity, and assuming that there has been, during this period, a spell of wet weather, then it may be possible to further reduce the monitoring, to be replaced with an occasional inspection.

The greatest hazard at the slope remains smaller scale, shallow landslides that transition into debris flows, and the possibility of boulder falls / rolls. The debris flows have previously proven to be destructive to assets at the slope toe. There is strong field and historical evidence that this process is likely to occur in the future. Given the large volume of comparatively fine grained material on the slope, this hazard is likely to persist for many years. The level of hazard associated with these failures exceeds that deemed acceptable within international standards, and I would therefore support the recommendation of mitigation. Whilst the existing catch bowl offers some protection, it is not large or extensive enough to adequately protect the whole area at risk. Extending this pit as per the report in order to increase the flow paths that are likely to be intercepted, and to increase the capacity of the pit, is a sensible, cost-effective and low technology approach that is pragmatic. I would also recommend that flexible barriers, which have proven to be effective in this role, are also constructed across potential flow paths. Great care will be needed to ensure that the design is appropriate and that they are adequately founded in order to prevent collapse.

The recent Christchurch earthquake sequence in New Zealand has highlighted the importance of rockfall mitigation that is effective during seismic shaking. A number of fatalities were recorded, and more than 500 houses have been permanently evacuated, as a result of rockfalls in even this comparatively small event sequence. The detachment of large blocks remains a substantive risk at this site, and appropriate mitigation should be emplaced. As per the report, the most effective approach is likely to be flexible barriers (in

Christchurch more natural methods of protection, such as the planting of shelter belt woodlands, proved to be surprisingly ineffective). Again, it is important to ensure that the design is appropriate and that the structures are well-founded.

I would like to make two final recommendations. First, there is a very clear need to ensure that the structures that are installed are adequately maintained, and that traps are cleared of debris. Unfortunately, if material is allowed to accumulate then the hazard can start to increase substantially. Second, great care should be taken in allowing people to reoccupy hazardous zones, and in permitting new developments in the vicinity of this slope. The potential for rockfalls and debris flows is such that increasing vulnerability due to higher numbers of elements at risk is unwise.

Please do not hesitate to contact me if you require any further information.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'D. D. Petley', with a large, stylized flourish extending from the end of the name.

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