

Ministry of Education  
39 Princess Street  
Christchurch 8140

Attention: Ms Gabrielle Wall

Dear Gabrielle

## Redcliffs School: Rockfall Hazard Mitigation Report - Peer Review

In accordance with your request via email dated 28 April 2016 for Tonkin & Taylor Ltd (T+T) to carry out a peer review of the above report issued by Eliot Sinclair & Partners Ltd (Eliot Sinclair) and dated 30 March 2016, we provide this letter summarising our review.

The scope of the review included:

- Peer review of all technical aspects of the report, including methodology and conclusions.
- Whether the cliff behind the school should be monitored.
- A consideration of the new proposed mitigation strategy in association with an update on the cliff face – whether it has behaved as expected since the GNS report was developed, and whether anything has occurred which would suggest that the modelling of the proposed new mitigation strategy is based on needs to be revisited.
- Engagement with Eliot Sinclair – both for input as required during the review, and for comment following the draft review findings.

Overall and from a geotechnical engineering perspective, we find that the technical aspects of the report, including the methodology and conclusions, are consistent with what we consider to be current and appropriate engineering practice associated with rockfall-related risks in the Port Hills area following the Canterbury Earthquake Sequence (CES). The rockfall modelling and evaluation of the runout of boulders and rockfall debris from the cliff faces adjacent to the school site appears to have followed appropriate methods of analysis and the resulting conclusions appear reasonable in light of the study context and analysis parameters. Much of the basis for their assessment of the rockfall-related risk to people is referenced to the GNS report on rockfall and risk assessment for Redcliffs<sup>1</sup> following the CES, which is considered appropriate.

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<sup>1</sup> Massey, C. I.; Della Pasqua, F.; Taig, T.; Lukovic, B.; Ries, W.; Heron, D.; Archibald, G. 2014. Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Risk assessment for Redcliffs. GNS Science Consultancy Report 2014/78. 123 p. + Appendices. <http://www.ccc.govt.nz/assets/Documents/Environment/Land/CR2014-78RedcliffsFINAL.pdf>

We are not aware of any significant change in the condition of the cliff face since the GNS work was carried out, which would be consistent with our expectations. Therefore, there is nothing that we believe would suggest that the analysis reported by Eliot Sinclair needs to be revisited.

With regards to monitoring of the cliff face behind the school, we concur with the conclusions in the Eliot Sinclair report that monitoring is not required, if the proposed risk mitigation works are implemented.

We do have the following comments although these would not be expected to impact on the conclusions made in the report.

For their rockfall risk assessment, Eliot Sinclair has adopted a level of acceptable fatality risk of  $1 \times 10^{-6}$ , which is for the risk of an individual fatality. This is consistent with guidance provided by GNS<sup>2</sup>, whom reported that an acceptable level of risk for a school is 100 times lower than  $1 \times 10^{-4}$  (which equates to  $1 \times 10^{-6}$ ). Precedent for this level of risk being acceptable can be found in the public domain. However, we are not aware that this is Ministry policy and do not necessarily agree that it should be, since there is also guidance suggesting that risk tolerability levels associated with natural hazards may be higher. However, we do agree with the Eliot Sinclair report's conclusion that the level of life risk to school users when considering their proposed mitigation works is sufficiently low that rockfall risk should not preclude occupying the school.

The current location of the barrier intersects an existing building, which is noted in the Eliot Sinclair report. Construction of the barrier would be expected to follow an alignment that would not conflict with the building, which would slightly reduce the separation distance from the cliff face for that portion of the barrier. However, we concur with the Eliot Sinclair report that this would not be expected to materially alter the level of risk and therefore the conclusions made in the report.

The proposed gabion basket rockfall barrier is referred to as "bund" in the Eliot Sinclair report. This structure is more akin to a rockfall fence, which may incur a slightly more intense future maintenance regime than a bund, as set out in the Christchurch City Council's guidance<sup>3</sup>. But in reality this makes no material difference, other than an increased frequency of inspection, which in any event is not expected to be a particularly onerous task for the proposed risk mitigation works.

We have not been provided with an estimate of the costs associated with the design, consenting, construction and maintenance of the gabion barrier. A robust estimate of these costs would be useful to feed into the Ministry's decision-making process. We suggest that the Ministry request this from Eliot Sinclair.

We also note that the proposed rockfall risk mitigation works would significantly reduce the operating area of the school. Although not an engineering-related issue, this is the main obvious impact of the proposed mitigation works and we expect that the Ministry is well-placed to evaluate the impacts of this in the context of the current school roll and whether there may any future roll growth.

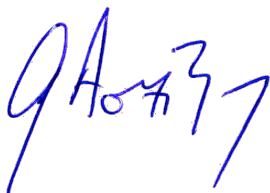
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<sup>2</sup> Taig, T., Massey, C., Webb, T. 2012. Canterbury Earthquakes Port Hills Slope Stability: Principles and Criteria for the Assessment of Risk from Slope Instability in the Port Hills, Christchurch. GNS Science Consultancy Report 2011/319. <http://www.ccc.govt.nz/assets/Documents/Environment/Land/gns-ph-riskassesscriteria12684519.pdf>

<sup>3</sup> Christchurch City Council. Technical Guideline for Rockfall Protection Structures. <http://www.ccc.govt.nz/assets/Documents/Consents-and-Licences/construction-requirements/approved-contractors/techguidelinerockfallprotectionstructures-mar2013.pdf>

We trust that this is sufficient for your current needs. Please do not hesitate to contact the undersigned if you have any questions or need anything further.

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15-Jun-16

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