

9 September 2015

Ministry Of Education
39 Princess St
CHRISTCHURCH

Attention: Gabrielle Wall

Dear Gabrielle

Redcliffs School

As requested, we have undertaken a review of the document *The Future of Redcliffs School*¹ and in particular Appendix A, and the comments made in the body of the document that relate to Appendix A.

Appendix A, entitled *Rockfall Risk to Redcliffs School* has been prepared by AECOM and includes:

- Commentary on the MWH August 2014 report which addressed potential mitigation of rockfall risk at Redcliffs School
- Commentary on the GNS Science reports referenced by MWH
- Independent assessment of the mitigation works proposed by MWH
- Commentary on a meeting attended by Don McFarlane (AECOM), Dr Jan Kupec (CERA), Dr Ian Wright (Christchurch City Council) and Steven Woods (MWH) on 5 May 2015 to discuss issues raised by the Board of Trustees with respect to the proposed mitigation works.

The conclusions of Appendix A are summarised in the table below, along with our commentary:

AECOM Conclusion	MWH Comment
1. The Technical Experts agreed that the engineering solution proposed by MWH is appropriate, robust and conservative, and will prevent disruption of the school in all but a large magnitude earthquake that generates very high PGA's at the site.	Agreed that solution is appropriate. Based on discussions at meeting on 5 th May it is not clear who the long term regulating authority will be and what the requirements will be for approving continued use of the school site. From a technical perspective, based on the best available modelling this statement is correct however, it is not known how onerous review and reporting requirements will be following more moderate rockfall events and therefore how much disruption will result from the review process.

¹ The Future of Redcliffs School, by the Redcliffs School Board of Trustees dated 30 June 2015

<p>2. Such an event will almost certainly leave large areas of Christchurch with significant damage, and thus Redcliffs is no more vulnerable or unsafe than other buildings and schools in the region.</p>	<p>Agreed that this is likely (as well as damage to roading and services around the Redcliffs/Sumner area). However, we believe Redcliffs School is more likely to face scrutiny around re-use following such an event due to the history of the site, the highly visible threat from the cliffs and the general conservatism and aversion to risk placed on school sites.</p>
<p>3. It is difficult to estimate the probability of an earthquake leading to catastrophic collapse of the cliff behind the school but both the field evidence from the 2010/11 earthquake sequence and rockfall modelling by GNS and MWH indicate that the likelihood of an event large enough to cause rocks to impact the bund is extremely low.</p>	<p>Agreed, the location of the bund is beyond the limit of rockfall from the best available modelling.</p>
<p>4. The most pessimistic estimates of possible future rockfall volumes are very much less than the volumes required to fill the area between the cliff and the proposed bund</p>	<p>Agreed, this is consistent with the MWH modelling.</p>
<p>5. The proposed bund is sited beyond both the previous and expected limits of rockfall runout and flyrock travel, effectively providing an extra level of protection by creating a physical barrier between the cliff and the school. This accounts for the uncertainty in the modelling.</p>	<p>Agreed, the intent of the bund was to provide additional security beyond the modelled requirements.</p>
<p>6. Even in the unlikely event of rockfall debris or flyrock reaching the bund, reassessment of the hazard and risk, and determination of the volume of rock (from such an event) to be cleared from behind the bund, if any, should be able to be completed within a matter of days.</p>	<p>From a technical perspective this may be true, however, without knowing what the regulatory requirements will be to undertake such work, the time requirement is uncertain.</p>

Section 2 of the Board of Trustees submission draws from the AECOM work and the statements regarding the level of conservatism in the design of proposed mitigation works are therefore supported by the technical work that has been completed. Statements concerning the time required to reassess the risk or return to the school site following a rockfall event cannot, in our opinion, be assessed at this time because it is not clear what the regulatory requirements will be and therefore what the assessment, reporting and review requirements will be. It should be noted that, as stated in the MWH August 2014 report, we believe it is unlikely that a future review of the cliff stability will find a more adverse situation than has currently been considered, however, the time required to undertake any future assessment work is uncertain. It may be possible to mitigate this uncertainty by engaging further with Christchurch City Council and/or CERA over a possible future operations and maintenance regime.

If you have any questions or require further clarification around issues raised by this review please feel free to contact the undersigned.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'S. Woods', with a long horizontal flourish extending to the right.

Steven Woods
Principal Geotechnical Engineer
MWH New Zealand Limited