

Education Report: Consideration of the future of Redcliffs School, Christchurch (3483)

Purpose of Report

1. This report provides information about cliff instability, hazard mitigation and risk assessment at the original Redcliffs School site. It outlines possible options for the future of Redcliffs School and its students, and asks you to indicate your preferred option for the next steps for the school.

Background

2. Redcliffs School is a Year 1-8 full primary school, originally located in Redcliffs, Christchurch, in the Port Hills electorate. It had a 1 July 2014 roll of 219 students. Further details about the roll of the school are provided in paragraph 31.
3. Redcliffs School suffered minor damage during the 4 September 2010 Canterbury earthquake. During that event, rockfall from the cliffs behind the school struck the school hall, the closest building to the cliffs.
4. Following this, a number of potentially unstable blocks of rock were removed from the cliffs, and a bund was constructed at the base of the scree slope to create a catch area and provide protection to buildings and occupants.
5. Substantial rockfalls then occurred during the 22 February 2011 earthquake. The consequent infilling of the storage area behind the bund increased the likelihood of boulders bouncing over the bund in the case of further rockfalls. Further mitigation measures were implemented in response to these developments. These included the disuse of the school hall, the relocation of the classrooms that had been closest to the cliff, the use of shipping containers and a mesh fence as barriers, and restrictions on the usage of areas of the school's western fields. *Must have been very frightening for the children.*
6. Further rockfalls occurred during the 13 June 2011 earthquake, and continuing instability in the cliffs around the school site led to the school's operations being relocated to Sumner School and then to the Van Asch Deaf Education Centre (VADEC) in the nearby suburb of Sumner. Redcliffs School students are currently being transported to the VADEC site from the Redcliffs area in Ministry-funded buses.
7. There have been no further major rockfall events since June 2011, although there have been smaller events due to ongoing seismic activity and weather effects on the cliffs. No rocks have been observed to reach the school grounds during this time. However it should be noted that further rockfall is predicted as the cliff continues to degrade. *This is a worry.*

8. In September 2012, you announced a number of proposals for changes to the schooling network in greater Christchurch. Redcliffs School was grouped in the Port Hills Learning Community Cluster, which has since changed its cluster name to 'The Bays'. The proposal for this cluster was that all schools would be repaired and would continue without change. However, it was noted at the time that the Ministry was waiting for completed geotechnical information, particularly for Redcliffs School, and that this information could change the proposals for the cluster.
9. The September 2012 proposal for the cluster is outlined in Table 1.

Table 1: September 2012 Proposal for The Bays (Port Hills) Learning Community Cluster

School	Type	Proposal
Heathcote Valley School	Yr 1 – 8	Repair and continue
Mt Pleasant School	Yr 1 – 8	Repair and continue
Redcliffs School	Yr 1 – 8	Repair and continue
Sumner School	Yr 1 – 8	Repair and continue

Reports Relevant to the Future of Redcliffs School

10. Four reports that are relevant to a decision about the future of Redcliffs School are discussed in this briefing, and are attached in full for your consideration. These reports are itemised in Table 2.

Table 2: Reports relevant to Redcliffs School

Title	Date (Final)	Prepared by	Commissioned by	Appendix #
<i>Redcliffs School: Cliff Instability and Hazard Mitigation</i>	August 2014	MWH New Zealand Ltd (MWH)	Ministry of Education	1
<i>Canterbury Earthquakes Port Hills Slope Stability: Principles and Criteria for the Assessment of Risk from Slope Instability in the Port Hills</i>	August 2014	GNS Science International Ltd (GNS)	Christchurch City Council	2
<i>Relative Risk at Redcliffs School</i>	September 2014	MWH	Ministry of Education	3
<i>Redcliffs School, Christchurch – Site Study</i>	June 2014	Beca Ltd	Ministry of Education	4

Investigations - Cliff Instability and Hazard Mitigation

11. In August 2011, the Ministry engaged MWH New Zealand Ltd (MWH) to provide geotechnical advice about the hazard presented by the cliffs immediately behind the Redcliffs School site.

12. MWH provided a draft report on its findings to the Ministry in April 2014. The report was not finalised at that time as the findings were subject to the completion of a wider mass movement report on areas to the north and west of the Redcliffs School site.
13. The mass movement report, commissioned by the Christchurch City Council (CCC) and undertaken by GNS Science International Ltd (GNS), was released on August 22 2014 (Appendix 2). The MWH report was subsequently finalised (Appendix 1). The Ministry contracted a peer review of the MWH report by Tonkin & Taylor Ltd, and the content of it has been agreed by the peer reviewers and the original authors.

Very thorough process.

Risk Assessment Framework

14. The GNS mass movement report outlines the development of a framework for assessing the risk posed by slope instability in the Port Hills. The report suggests that the acceptable level of risk for sensitive developments such as schools is an Annual Individual Fatality Risk (AIFR) of 10^{-6} . An explanation of AIFR is provided as Appendix 5.
15. An AIFR level of 10^{-6} is the background level of risk that all New Zealanders are exposed to, and is equivalent to an annual risk of one in 1,000,000. In comparison, a level of risk of 10^{-4} (one in 10,000) is considered to be acceptable for residential areas. The latter is the level that has been used as the basis for deciding whether or not residential properties in the Port Hills are suitable to occupy.
16. MWH notes in its report that "There is no regulated guidance on the level of risk that is acceptable for a school site, Christchurch City Council's Technical Guidelines for Rockfall Protection Structures notes that any protection structure must be designed to reduce the annual individual fatality risk below 10^{-4} , but is no more specific."

that children are safe, + they perceive that they are safe.

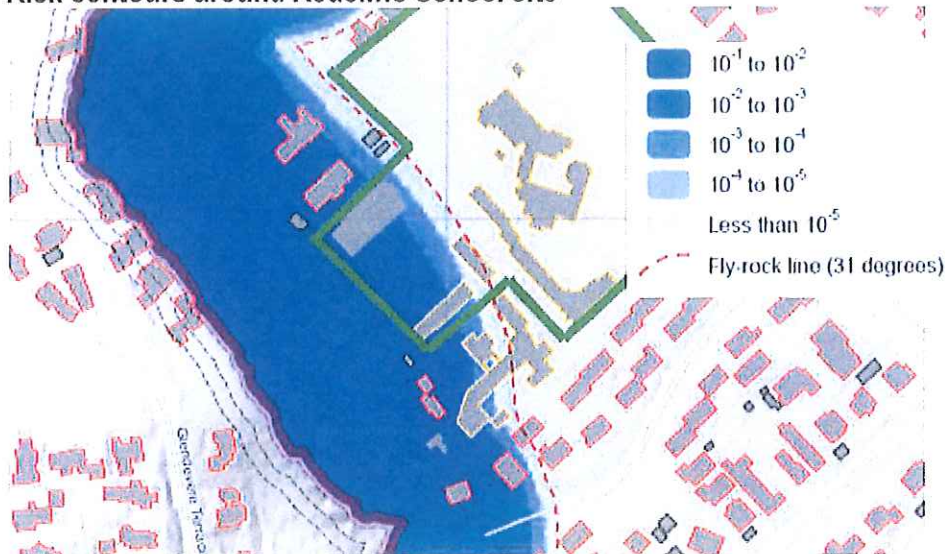
Site Risk and Mitigations

17. The MWH report utilized the latest GNS computer modelling available for cliff instability assessment, which includes mass movement and cliff face collapse. The modelling undertaken takes a highly conservative approach, whereby the hypothesis is for large scale cliff collapse. While there is no visual evidence for global instability, the cliff above Redcliffs School has been progressively degrading since the February 2011 earthquake, and large scale failures have occurred under similar circumstances at other locations. GNS note that crack patterns suggest larger failures than have occurred to date could occur in the future. The potential for larger scale cliff collapses has been considered in the updated modelling work by GNS.
18. Although MWH considers it likely that the protection measures put in place following the February 2011 earthquake are sufficient to contain even a large-scale rockfall event, it considers that the ongoing degradation of the cliffs and the need to provide a high margin of safety for a school site would necessitate further mitigation measures. Specifically, it recommends that if the school is to be returned to the site, the following measures should be undertaken to mitigate hazards:
 - a. Abandonment of the part of the site that is closest to the cliffs (resulting in a reduction in the size of the site by approximately 10%); and

- b. construction of a 3.9 metre high mechanically stabilised earth bund along the revised Western and Southern boundaries of the site.
19. Revising the site boundaries as recommended by MWH would mean that the entirety of the site would be at a sufficient distance from the cliffs to have an AIFR of 10^{-6} . As noted above, 10^{-6} is the background level of risk that all New Zealanders are faced with, and is the level that GNS considers to be acceptable for sensitive developments such as schools. Figure 1 illustrates how the site could be curtailed to mitigate the rock fall risk.

Figure 1:

Risk contours around Redcliffs School site



Revised school boundaries used in modelling



20. While withdrawal from the parts of the site closest to the cliffs is sufficient to achieve an AIFR of 10^{-6} , the construction of a bund along the cliff-facing boundaries is recommended by MWH as a secondary measure of protection if the school is returned to the site.

21. Modelling undertaken by both GNS and MWH suggest that it is extremely unlikely that large volumes of debris would reach as far as a barrier on the revised boundaries of the site. The barrier would be beyond the maximum rock roll distances identified by GNS modelling. Such a barrier would therefore be designed for individual "freak" boulder strikes that may not have been captured by GNS risk modelling.
22. The recommended structure for this barrier is a mechanically stabilised earth bund, which would be able to absorb considerable energy without excessive damage or deformation. The bund would have a total height of 4.2m, 0.3m of which would be below ground level.

that would be very intimidating for 1-2m high little people.

Ongoing Monitoring and Future Reassessment

23. MWH anticipates that while fallen rock would accumulate behind the bund in future, this would generally not need to be removed. However, should a large volume of rock fall, it would be necessary to reassess the slope and confirm an appropriate course of action and any further mitigations that may be required.
24. MWH also modelled the damage that a large individual boulder could cause to the bund, and has concluded that a 95th percentile boulder (approximately 3m³) rolling from the top of the cliff would penetrate up to a metre into the bund. While MWH concluded that the bund would withstand an individual strike of this force, such an event would require a partial rebuild of the bund.
25. If Redcliffs School is returned to its former site with the recommended mitigations in place, MWH recommends that an operations and maintenance plan be established to define the response required after different-sized rockfall events. The MWH report is silent on the content of such a plan.
26. The Ministry agrees that if the school returned to its former site, an ongoing operations and maintenance plan would be required. With further rockfall predicted as the cliff continues to degrade, ongoing monitoring would be needed to ensure that the site remained within an acceptable level of risk (which, based on the GNS report, is an AIFR of 10⁻⁶).
27. If a future rockfall event occurred that required reassessment of the site's risk level, children would not be able to continue learning on the site while the assessment and any required repairs, removal of rock or other mitigations were carried out. Consequently, a plan would need to be in place for a further temporary relocation of the school. If this possibility eventuated, the children, their families and staff at the school could face the same sort of disruption and uncertainty that they are dealing with in the school's current situation.

That's important to get a idea of what might be needed

This ongoing uncertainty is a worry

Comparative Risk

28. To understand the AIFR for the Redcliffs site in a wider context, the Ministry commissioned MWH to carry out a comparative risk report. This compared the level of risk at the Redcliffs site from cliff instability and rockfall, tsunami and ground deformation with risk levels at other Christchurch schools. The resultant report, *Relative Risk at Redcliffs School*, is attached as Appendix 3. The findings of this report are summarised as follows:

Rockfall

The assessment found that if the recommended mitigation works were undertaken, the site would have no higher level of risk from rockfall or cliff collapse than other school sites in Christchurch, although there would be a residual level of rockfall risk for people travelling on the road network to and from the school. This hazard is considered to be present on many roads in and around the Port Hills network, and would not be unique to people travelling to and from the school site.

*That's
reassuring*

Tsunami

The risk of inundation from tsunami at the Redcliffs School site was found to be similar to that at neighbouring North New Brighton School and lower than that at South New Brighton School, Sumner School and Van Asch Deaf Education Centre.

✓

Ground Deformation

The Redcliffs School site is considered to be at a similar risk of ground deformation (liquefaction) resulting in damage to school infrastructure as the majority of schools in Christchurch.

✓

29. The Ministry contracted a peer review of this comparative risk report, and the content of the final report has been agreed by the peer reviewers and the original authors.

✓

Property Implications of a Return to Site

30. The Ministry contracted Beca, a multi-disciplinary consultancy firm, to provide a report about possible property redevelopment and configuration options for the Redcliffs site. This report, *Redcliffs School, Christchurch – Site Study* is attached as Appendix 4. This was required because of the mitigation measures recommended by MWH, which would reduce the Redcliffs School site to an area of 1.83 Ha. The report explored the options for the future use of the remaining school buildings and provided a plan that demonstrated the optimum functionality of the site.
31. Table 3 shows the estimated costs of returning to the Redcliffs School site, either through repairing the existing buildings, or by constructing new buildings. The Ministry has received an indicative cost of \$1.5 million for the construction of the recommended bund, although the true cost would not be known until this went to market.
32. These figures allow a comparison of the relative costs of the two proposed property solutions. However, it should be noted that the timing of possible construction is yet to be determined due to pending demolitions (see Timing Considerations section), and the true cost of either solution will be subject to inflation over time. The actual cost can therefore be expected to be higher than the current estimates.