

Tauranga District Council
Private bag 12022
Tauranga

17 August 2007

For the attention of s 7(2)(f)(ii)

Rockfall on Mauao; 31 July 2007

Please find set out below a summary of our recent rockfall event and our subsequent investigation.

Description of the rockfall event and site inspection

On Monday 30th July a member of the public reported to TDC's Mauao Ranger's office that they were narrowly missed by a rockfall crossing the Base track on the North Western side of Mauao.

TDC staff investigated and found a number of rocks on the base track (which it later appears were probably not part of this rockfall) and significant damage to the Oruahine track.



Photograph 1; Oruahine track damage

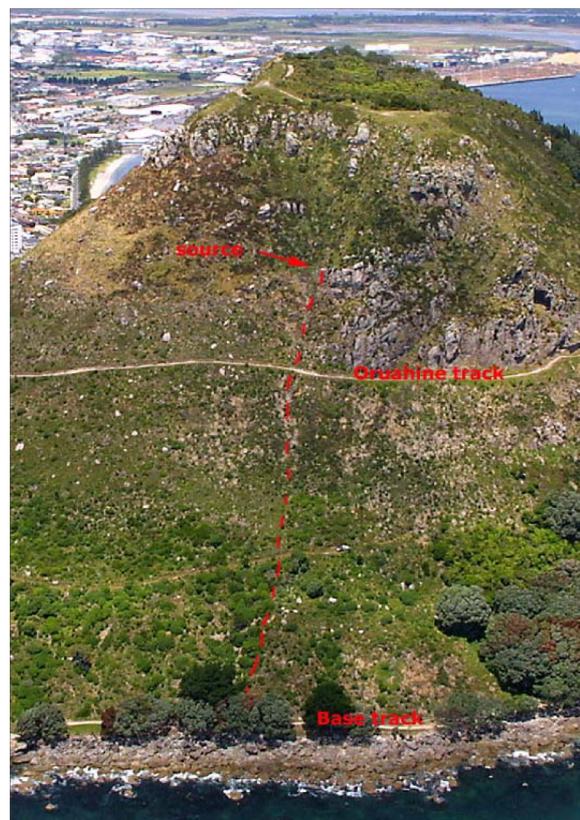
This track damage was clearly caused by a relatively large rockfall.

On Tuesday 31st s 7(2)(f)(ii), TDC Mauao Ranger, called s 7(2)(a) f Privacy with Avalon.

On Wednesday 1st s 7(2)(a) f Privacy carried out a reconnaissance which consisted of:

- Reviewing the track damage
- Tracking bounce impact damage and rockfall debris down to the base track.
- Locating the source of the rockfall.

The source of the rockfall was found to be the front area of an overhanging rock outcrop approximately 150m vertically above the Base track, 40m above the Oruahine track.



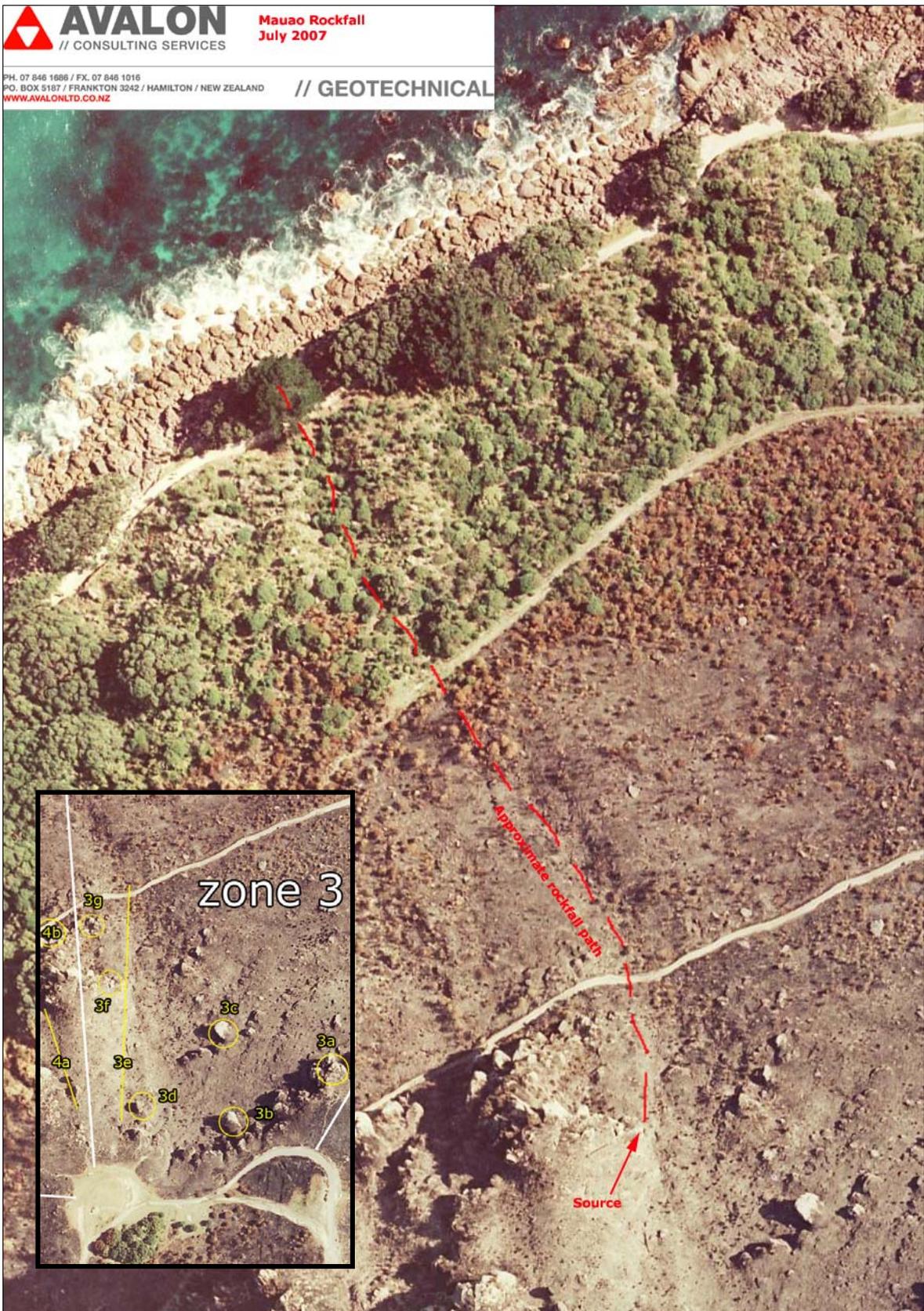
Photograph 1 & 2; Source outcrop and rockfall path.

Adjacent to the failed outcrop is a gully which guided the rockfall down the slope.

This gully was identified as 3e in previous reports as it was a well known high risk rockfall route, recommended as a possible site for rockfall fencing.

It is unknown exactly how much rock crossed the Base track; however, Avalon's previous rock scaling in this area demonstrated that many rocks falling down this particular gully do reach the shoreline.

Avalon carries out monitoring of rockfall and slips on Mauao's slopes every six months and this includes keeping a photographic record of high risk areas.

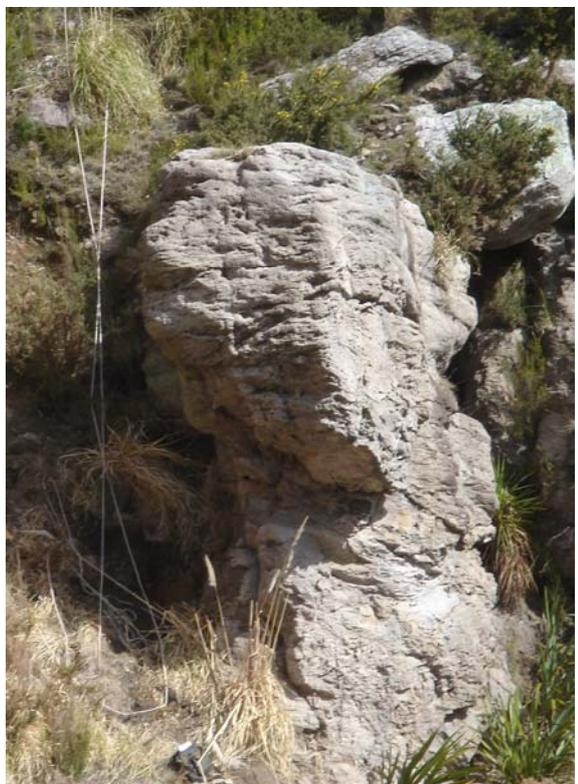
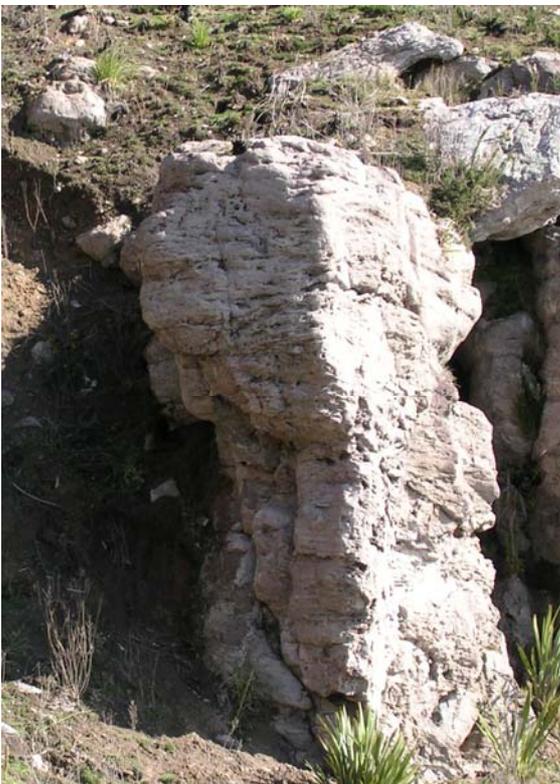


Photograph 3; Source location and rockfall path – gully 3e.

In July 2004 Tauranga experienced a swarm of minor earthquakes which triggered a number of rockfalls and slips on Mauao. One small slip was from the side of the outcrop in question therefore we have a number of photographs which show detail of this rock outcrop before the recent failure.



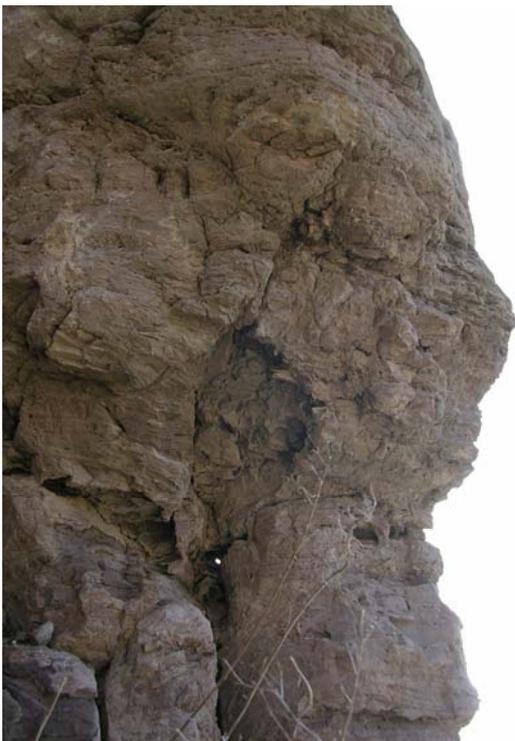
Photograph 3 & 4; 2004 vs. 9 August 2007.



Photograph 5 & 6; 2004 vs. 9 August 2007.



Photograph 7 & 8; 2004 vs. 9 August 2007.



Photograph 9 & 10; 2004 vs. 9 August 2007.

Approximately 3m³ (7.5 tonnes) of rock failed from an area 3m high x 2m wide. Initially the falling rock was probably in two or three large boulders but these continued to break up as they bounced down the slopes.

Impact scars show the boulders would have been spinning and bouncing high into the air. The initial distance between impacts is around 5 to 10m.

Much of the rockfall does appear to have come to rest between the Oruahine and Base tracks. The typical size of the larger boulders located in the bush is 300kg.

The remaining outcrop is clearly of questionable stability but could not be safely inspected any further without rope access equipment so it was decided that Avalon should return as soon as possible to carry out a close inspection.

s 7(2)(a) f Privacy returned to site on the 9th August with rope access equipment, track lookouts, hazard management and OSH notifications in place.

Anchorage and ropes were rigged and the rock was inspected for signs of movement on all joints and rock/soil interfaces. The geometry of the block and the degree of overhang was assessed to make a judgment on the likely stability.

A close inspection of parts of the failure surface showed it to be coated in fine rock dust and fragments, indicating that the rock which detached was under compression when it failed (as opposed to simply becoming detached in tension and toppling forward and outward).

The remaining hazard & risk

As the rock failed in compression it must have been supporting some load from the outcrop above, which is now left more severely overhanging and less stable.

The remaining rock mass is open jointed all around and significantly overhanging. Viewing it from all angles it appears little is keeping it in place.

Assessing the stability is inevitably somewhat subjective, however, given our experience on Mauao, in our judgment the remaining rock mass appears more likely to fail within years rather than decades.

A potential further failure could involve 50 to 100m³ of rock which would break up into many smaller pieces whilst falling the 150m vertically down to the base track.

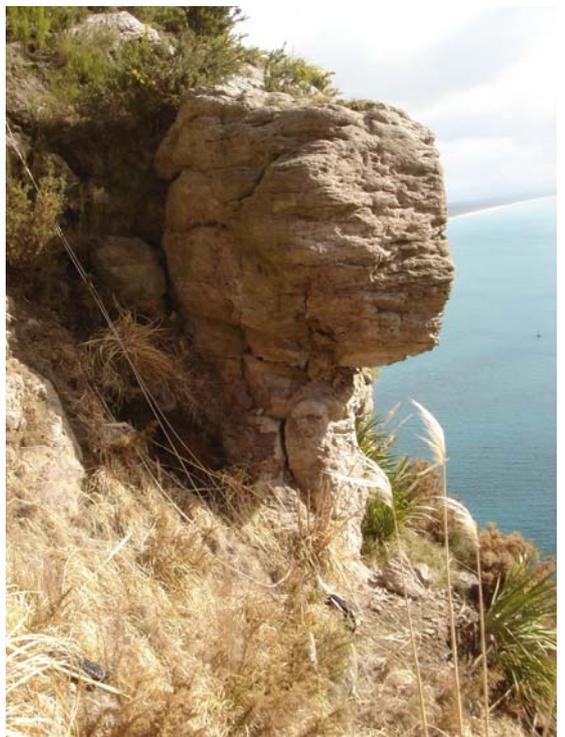
Whilst some rock would come to rest on the slope, much would reach the shoreline. Our experience when rock scaling after the 2003 fires was that rock falling from this zone often crosses the base track with very high velocity.

We could expect rockfall to cross say a 100m width section of the base track, a very severe hazard.

The slopes immediately above the track are vegetated to such a degree that persons hearing rocks coming towards would probably be unable to see them, thus possibly not giving them time to move out of the way.



Photograph 11 & 12; General views.



Photograph 13 & 14; General views.

Mitigation options

Leaving the rock stack and setup a monitoring programme

An option to leave the rock stack and monitor it on a gradually extended time scale i.e. start off fortnightly and then depending on results push it out to monthly and biannually could be seen as an option.

This could be seen as taking a considered proactive response that could produce concrete evidence either way as to remove or not.

The potential drawbacks with this are that we do not know how much movement the stack has undergone (if any) from the point of release until now. If the stack has experienced some movement then it could already be close to it's tipping point.

For this reason leaving the rock stack could be a gamble that we have no way of knowing the size of.

Removing the remaining rock stack by blasting

Options for dealing with this marginally stable rock mass are limited. There are many points to consider due to the high profile nature of the Mauao with local and regional public interest.

Mauao would appear to be as popular as ever, this both increases the need to listen public opinion (regarding blasting and changing the face of Mauao) and the need to deal with a potentially very dangerous hazard.

It is possibly a situation of damned if you do and damned if you don't.

Avalon is acutely aware of the sensitivity surrounding Mauao and would not jump to suggesting such measures as blasting so easily.

If the blasting option is adopted then we will carry out the work with all due care and diligence.

Please contact me if you have any queries. I look forward to hearing from you.

Regards

s 7(2)(a) f Privacy

For Avalon Industrial Services Ltd

August 18, 2007