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GEOTECHNICAL

Tauranga District Council
Private bag 12022
Tauranga

30 August 2021
Avalon Project #22102

For the attention of S 6(c)-Mainte, Natural Environment Advisor (Mauao)

Dear s 6(c) - Maintenance of Law

Mauao Slopes; Rockfall incident response and Routine monitoring report August 2021

On the 2 August a member of the public reported a rockfall event to the Ranger's office.

At your request Avalon's team comprising s 7(2)(a) - Privacy and two Rope Access Technicians, visited the site on 16 August. The aim was to carry out an inspection of the rockfall source location, checking stability, looking for impact evidence down the fall line and atempt to locate it's resting place below the Waikorere track.

The inspection of the rockfall site took until late morning, after which we carried out the routine EDM survey of the Bluff movement monitoring locations.

Avalon's s 7(2)(a) - Privacy carried out a full track walkaround and monitoring locations inspection plus further investigated the "sinkhole" reported as Item 9 in our March 2021 Monitoring Report.

1. Rockfall Reported on 2 August

The rock in question was reported as "boogie board sized" so presumably relatively thin and around 0.5 to 0.8m along the sides.

It impacted the Waikorere track a few metres in front of the person in question. The person reportedly had heard the rockfall whilst it was rolling/bouncing down from above, then saw it exiting the bush just above the track and thus were able to safely move away from the fall line.

The location on the Waikorere track is indicated on the following aerial photo, Photo 1.

Photo 1; The rockfall crossed the Waikorere track at this location.

2. Waikorere track Rockfall Risk Evaluation

From the description the rock's weight could have been around 100kg, clearly large enough to present a risk of fatality to a person in it's path.

"Disk" shaped rocks such as this tend to spin when falling, allowing them to travel further than spherical or cube shapes.

Our most recent numerical rockfall risk evaluation (2020) was based on an estimate that 2 to 3 rocks of this size cross the Waikorere track per year, which outputs the risk level to an individual on one crossing as 1.2 E-7, well within the tolerable individual level. With present visitor numbers this risk level equates to a fatality incident return period of around 26 years.

In the previous 18 years, since our monitoring commenced in 2003, as far as we are aware members of the public have only reported one other incidence of rockfall crossing the Waikorere track. In July 2018 a Waikorere rockfall involved multiple pieces up to 300mm in diameter.

3. Rope Access Inspection of the 2 August Rockfall Site

Two technicians spent around an hour on the rock bluff and slope down to the Waikorere track. They did not find any evidence of the rockfall source location nor of it's fall line through the bush. They also inspected the bushed slope below the track but did not find the rock in question.

Our inspection team did not locate any specific remaining hazards or any particular marginally stable larger sized rocks. There are however numerous small, loose surface rocks of up to around 150mm diameter, trapped in vegetation.

4. Other reported rockfall since previous monitoring

We understand that there has been no other rockfall reported to the ranger's office or campground since our previous monitoring.

5. Sinkhole on the lower slope, above the campground

This was found on our previous monitoring walkover and reported as Item 9 in our March 2021 Monitoring Report.

The springs that issue around the lower colluvial slopes around Mauao indicate widespread underground water flow. Underground drainage routes will tend to form at levels where sandy, relatively permeable colluvium, overlies impermeable clay (weathered volcanic ash) layers. The 'piping' effect, scouring out sand, can create open 'pipes', 'small tunnels'.

This feature looks likely to be a 1m3 or so void collapse above a small underground watercourse in a natural "pipe", scoured out by flowing water.

On this inspection we probed the 'tunnel' with a borehole camera and light source on extendable fibreglass poles.

Photo 2; The sinkhole at the surface (2m scale).

Photo 3; The sinkhole entrance.

Photo 4; Looking further in the 'tunnel' appears to continue to the right. A small pool of water can be seen on the floor.

Photo 5; The tunnel continues to the right. Furthest view in photo is around 5m from the entrance. The diameter of the tunnel here is around 0.5m.

6. Rockfall onto Base Track

Photo 6 & 7; A recent rockfall from the actively eroding slope above the Western Base track.

As has been the case for many years, this slope continues to actively erode and generate occasional falling rock.

We recommend that this particular slope should continue to be scaled regularly as required, as new surface rocks are exposed.

7. Loose surface rock above the Oruahine track

Photo 8; Rock resulting from a small soil slip above the Orahine track.

In this case the rock is only 2m above the track so does not present a hazard but it illustrates how small soil slips and erosion continue to bring new rock to the surface.

8. Exposed Projecting Boulder above the Goat track

See photographs on following page. This boulder has now eroded out to such a degree that it may be marginally stable.

The location is at the crest of an exposed slip face around 10m above the mid Goat track. The boulder does pose a hazard to persons using the track below.

This boulder appears likely be able to be scaled relatively easily. Although it is unlikely to pick up enough speed to reach the Base track, there is a small possibility that it may therefore a temporary Base track closure would be required.

Photo 9, 10, 11; Overhanging boulder above Goat track.

9. Persons off track on the bluff edge above the Waikorere track.

Just a quick note that we regularly observe persons leaving the designated tracks and accessing the bluff edges.

Photo 12; Off track persons on bluff crest above Waikorere track.

We have no reason to believe such persons triggered the 2 August rockfall, although it is possible.

Of course these persons are at risk of falling, however, we are not aware of any accidental falls and the vast majority of visitors do not leave the designated tracks as these perons have actively chosen to.

10. Slip scar above southern 4WD track

This slip scar does not present any hazard to persons but has been actively eroding and enlarging for 16 years. The location is 37° 38′ 1.8494″ S, 176° 10′ 17.0897″ E

Tauranga DC, Mauao Flood Damage 2005 10

8.	Slip 120m (up slope distance) above 4WD track. 3m wide x 3m up slope x 1m deep. Debris including rock swept to 4WD track. Some rock & boulders at rest on old farm track mid slope. Boulders in unstable positions on slip scarp.	Scale rock debris from slip and debris slope & locally re-profile slip crest. Seed.
	track.	
7.	Slip 100m (up slope distance) above 4WD track. 2m wide x 2m up slope x 1m deep. Moderate seepage. Debris including rock swept onto 4WD track. One 0.6m3 boulder at rest on slope 6m below slip scar. Other debris spread below.	Scale rock debris from slip and debris slope & locally re-profile slip crest. Seed.

This slip was triggered by a large storm event in May 2005. 350mm of rain fell in 24 hours. It was initially two smaller slips, designated #7 and #8 out of a total of 52 slips generated by that rainfall event.*Extract from Avalon Report 0534B*

These separate slips eventually joined together and continued to expand, resulting in the picture today. Planting efforts have helped slow the erosion rate.

Photo 13; Slip from above. Note midden on right.

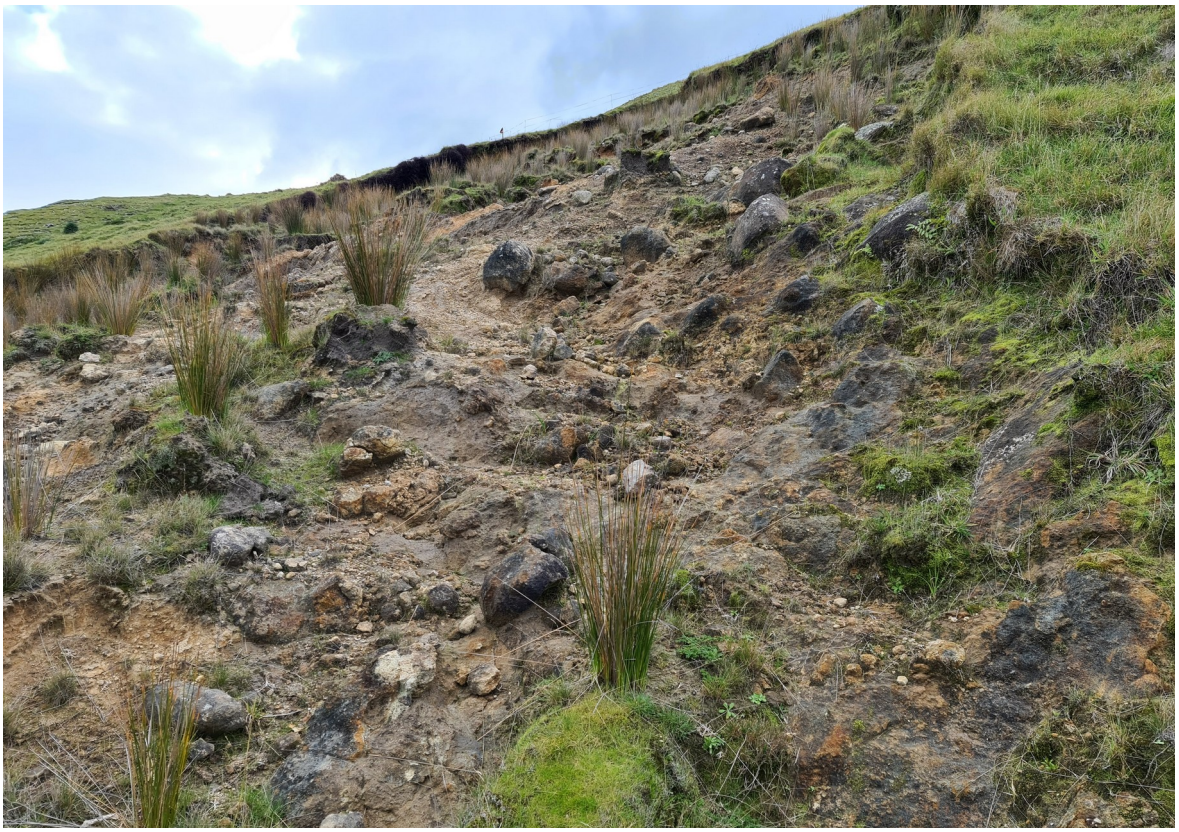


Photo 14; Slip from below. Very rocky, difficult for vegetation to establish.

11. Bluff survey

The benchmark survey found no significant recent movement on the high bluffs which are monitored.

11. Photographic Survey

At each monitoring visit since 2003 we have been taking photographs at 13 locations/viewpoints to document changes in erosion and vegetation on Mauao.

When this project started large areas of the upper slopes were devegetated following widespread fires in 2003.

The slopes are now recovered to the point where the original monitoring locations no longer offer ideal views of ongoing changes. For this reason from now onwards we will be using a different set of locations.

For the record Appendix A includes relevant photographs from the post 2003 fires investigation; Avalon Report #0314

If you have any queries please don't hesitate to contact me.

Regards

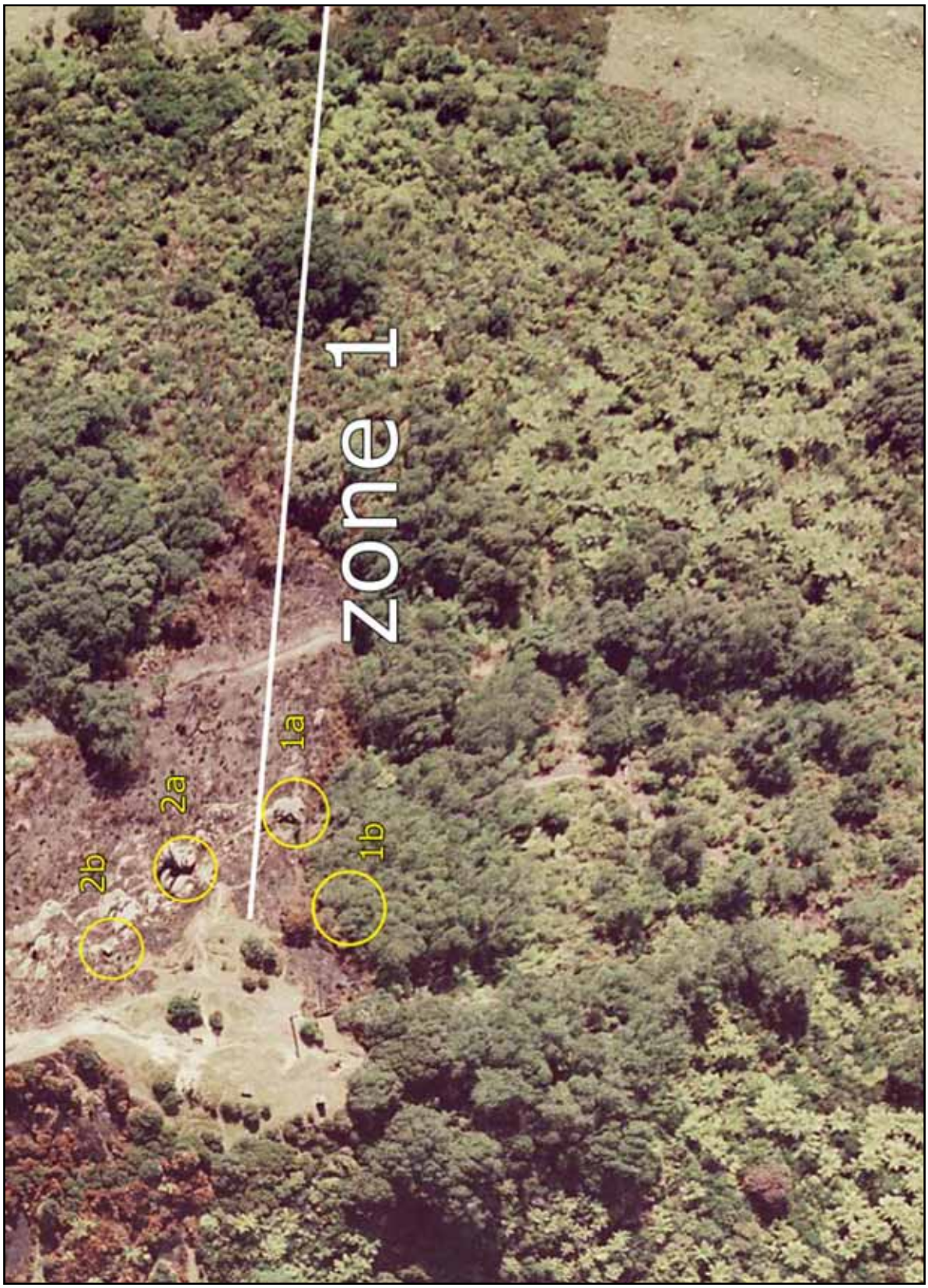
[redacted]
s 7(2)(a) - Privacy

Appendix A: Photographs after the extensive fires in 2003

Photograph No 1; Aerial view of Mauao.

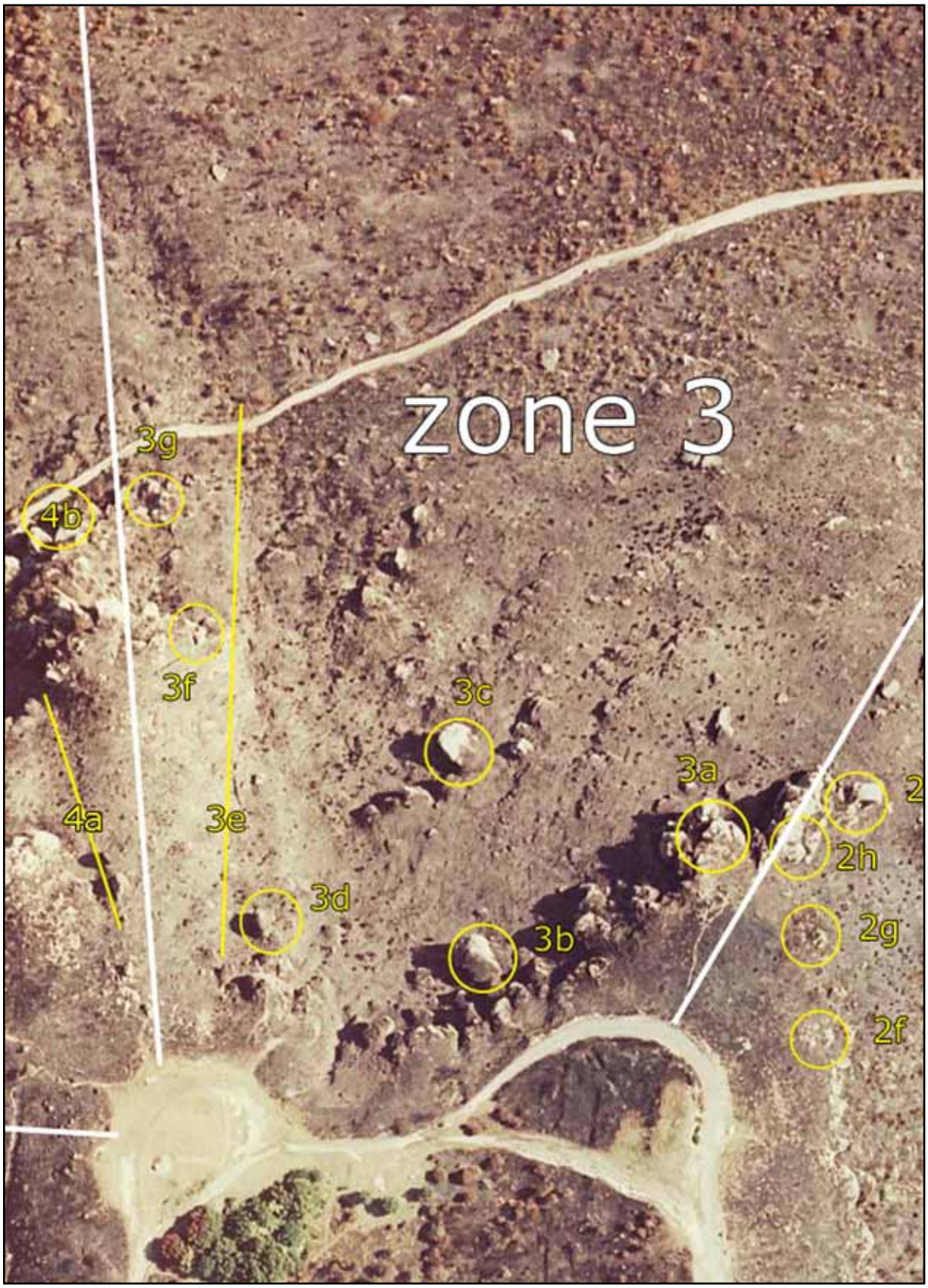
Photograph No 2; Aerial view of the rock slope zones.

Photograph No 3; Aerial view of zone 1.



Photograph No 4; Aerial view of zone 2.

Photograph No 5; Aerial view of zone 3.



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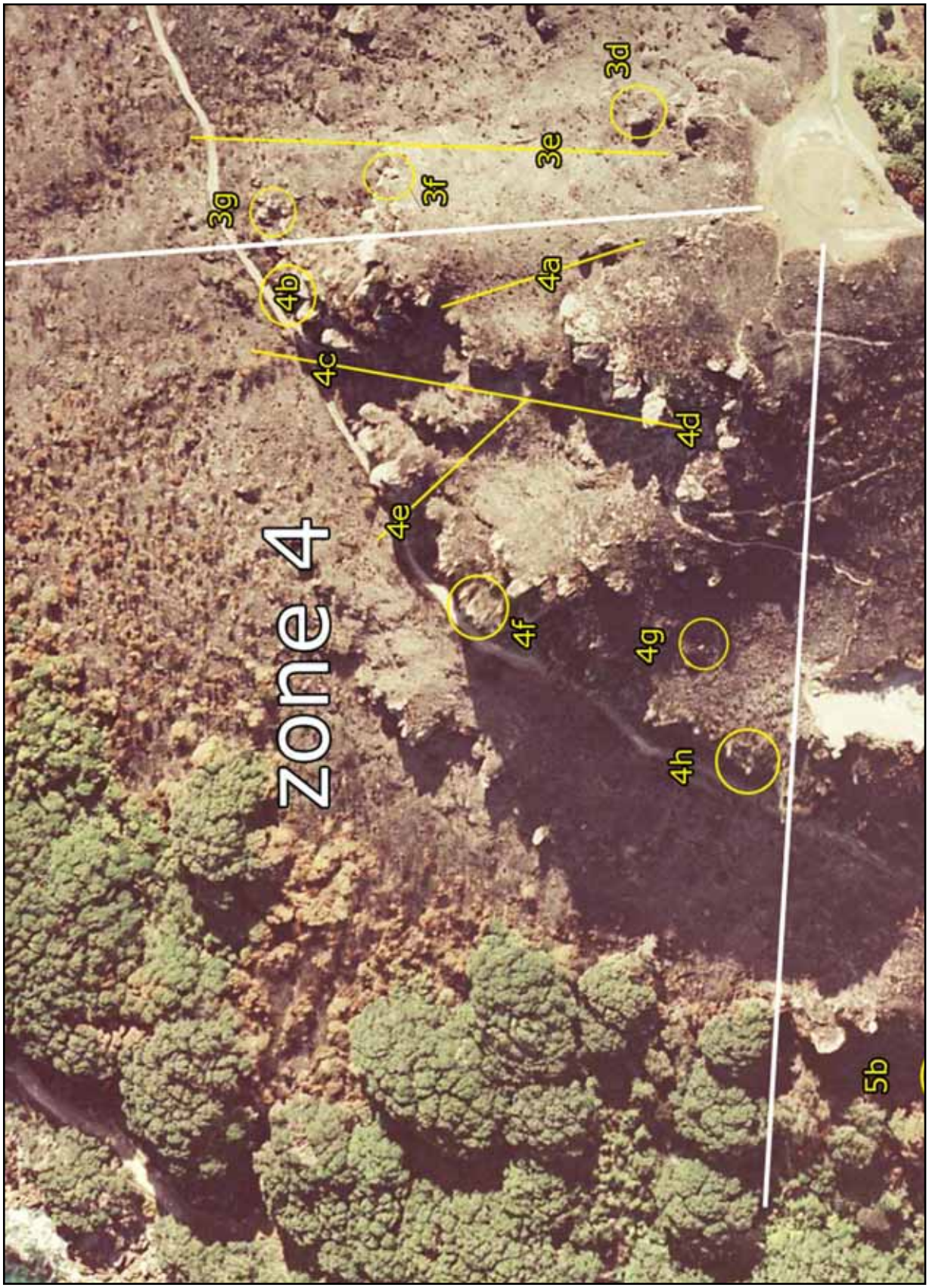
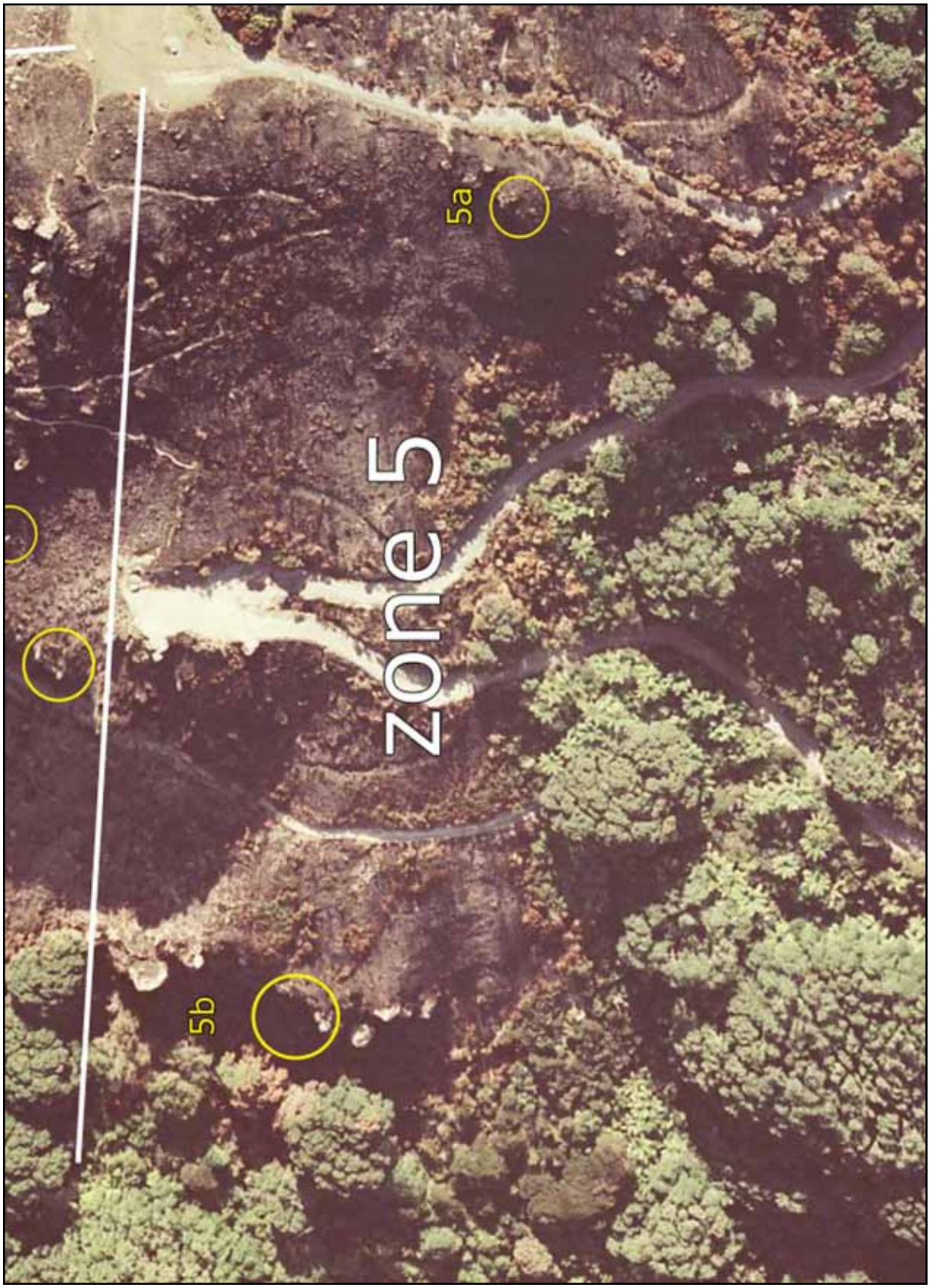
Photograph No 6; Aerial view of zone 4.



Photograph No 7; Aerial view of zone 5.



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Photograph No 8; View to zone 1 & 2 from Base track.

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Photograph No 12; *2a* view from rock face to south.

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Photograph No 18; View up into zone 3 from the Oruahine track.

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Photograph No 19; Top of bluff at *3a*.

Photograph No 20; View down to *3b*.

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Photograph No 21; View down to *3c*.

Photograph No 22; Unstable column at *3d*.

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Photograph No 23; View into gully at *4a*.

Photograph No 24; Rock climbing crag at *4b*.