MINE SHIFT: Examining Ground Displacement Impact On Mines Around The World

The Warning Signs At The Cadia Tailings Dam

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Details of community complaints and ongoing proceedings by the New South Wales Environment Protection Authority (EPA) are from public reports and are used solely to provide context to recent events at Cadia. They are not included to allege any wrongdoing.

The Cadia Story

For the people living in the Cadia and Errowanbang valleys of New South Wales, Australia, the past five years have seen them endure a difficult and troublesome relationship with the neighbouring Cadia gold mine.

Complaints and reports of compromised air quality began surfacing - and then increasing in volume - shortly after a collapse of the mine's north tailings dam wall in March 2018.

The breach was sudden, with the site's owner, Newcrest, releasing in a statement they'd be alerted to a potential risk only after "the identification of cracks earlier in the day during a regular inspection"[1]

Fortunately, most of the tailings behind the wall didn't collapse, preventing large-scale release of material into the surrounding environment and allowing the area around the breach to be secured.

In the years that followed, however, despite reassurances of pollution tests finding the air quality matching acceptable limits, the reports and complaints about "white dust" [2] in the air continued.

The Cadia Story (cont'd)

Eventually, an independent air quality report "established a single vent rise in the mine's underground filtration network was emitting 18 times the legislated amount of particulate matter including respirable crystalline silica, which has been linked to the incurable lung disease silicosis".[3]

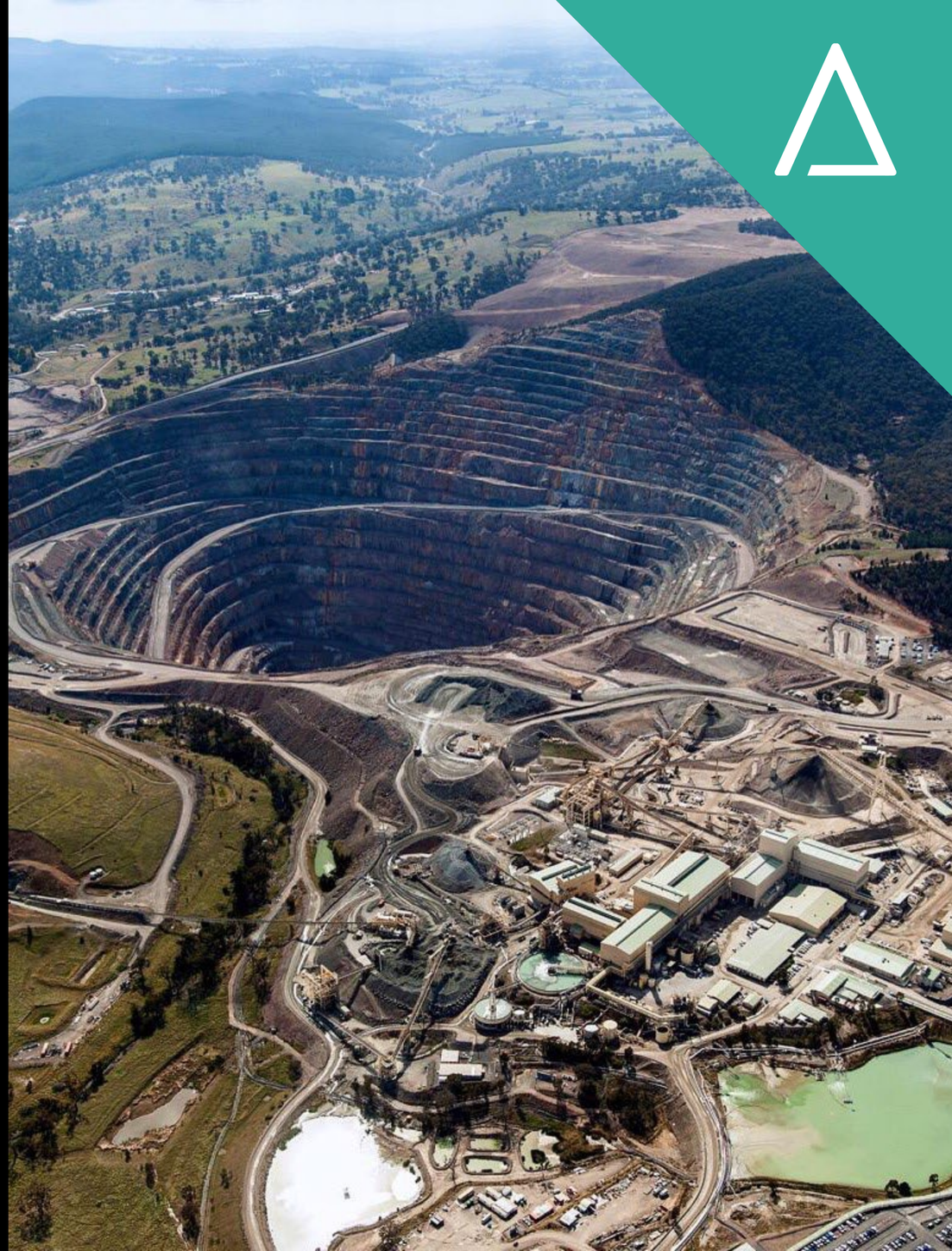
The findings led to proceedings by the New South Wales Environment Protection Authority (EPA), who allege the underground venting meant "the mine exceeded clean air regulations in March 2022 [...] which is in breach of section 128 of the Protection of the Environment Operations Act". [3]

impact on communities why CATALYST is dedicated to supporting the mining industry to mitigate with always-on, precision monitoring using remote sensing and earth observational solutions.

Key to which is early detection.

In this Mine Shift, our focus is on that initial wall collapse back in March 2018 to see what role remote sensing could have played in identifying potential ground displacement warning signs ahead of the mine's routine manual inspections.

Read on to learn more about what we found.



Why did the wall fail?

Late on Friday 9 March 2018, a portion of the wall connecting two tailings storage areas at the Cadia gold mine 'slumped'.

There had been no previous warning signs or cause for concern until earlier the same day when cracks were identified and reported by the on-site team. Fortunately, the tailings released were captured in the second dam, avoiding major environmental and humanitarian catastrophe.

The site was secured, and a comprehensive geotechnical monitoring system was introduced before an Independent Technical Review Board were appointed to conduct a full review.

A year later, it concluded "the dominant factor [...] was the existence of a low-density foundation layer in the vicinity of the slump,"[4] which had not been identified.

It also highlighted the "local height of the dam, prevailing phreatic conditions, and excavation at the toe of the structure in the area of the slump"[4], meant the weaker structural integrity of the wall couldn't handle the pressure, resulting in the collapse.

This deformation triggered liquefaction of part of the tailings, causing it to slump forward and spill into the second dam.

Fig.1

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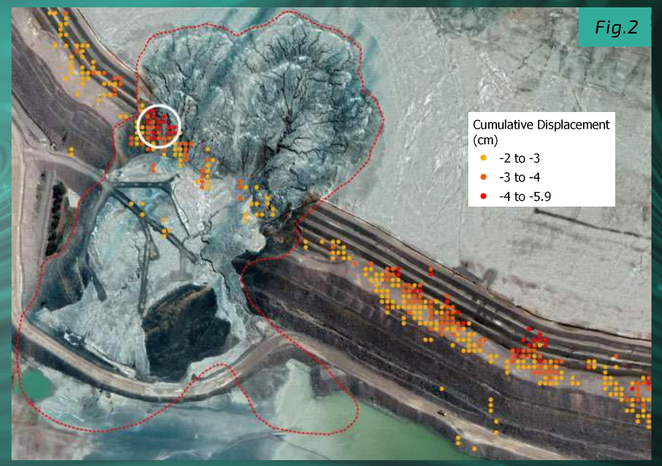
Were There Signs?

Fig.1

Fig.2



Combining satellite imagery of the breach with historical InSAR analysis, our team identified several areas of negative ground displacement spanning the length of the wall at the point of failure.

As you can see in Fig.2, multiple points of movement downward of -3cm to -5.9cm displacement occurred on the western point of the breach, suggesting this was the critical area of weakness in that part of the wall.

But not the only point.

There are evident weaknesses in other areas of the wall (Fig.5), with higher density pockets of negative displacement points clearly visible either side of the breach.

In events such as these, having this visibility means maintenance teams charged with securing the site are more informed to not only the breach site but the status of the other potential at-risk areas.

Equipped with this data, they are safer, more effective, and more prepared to carry out their planned or emergency repairs.

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Were There Signs?

Ultimately, though, prevention is better than cure.

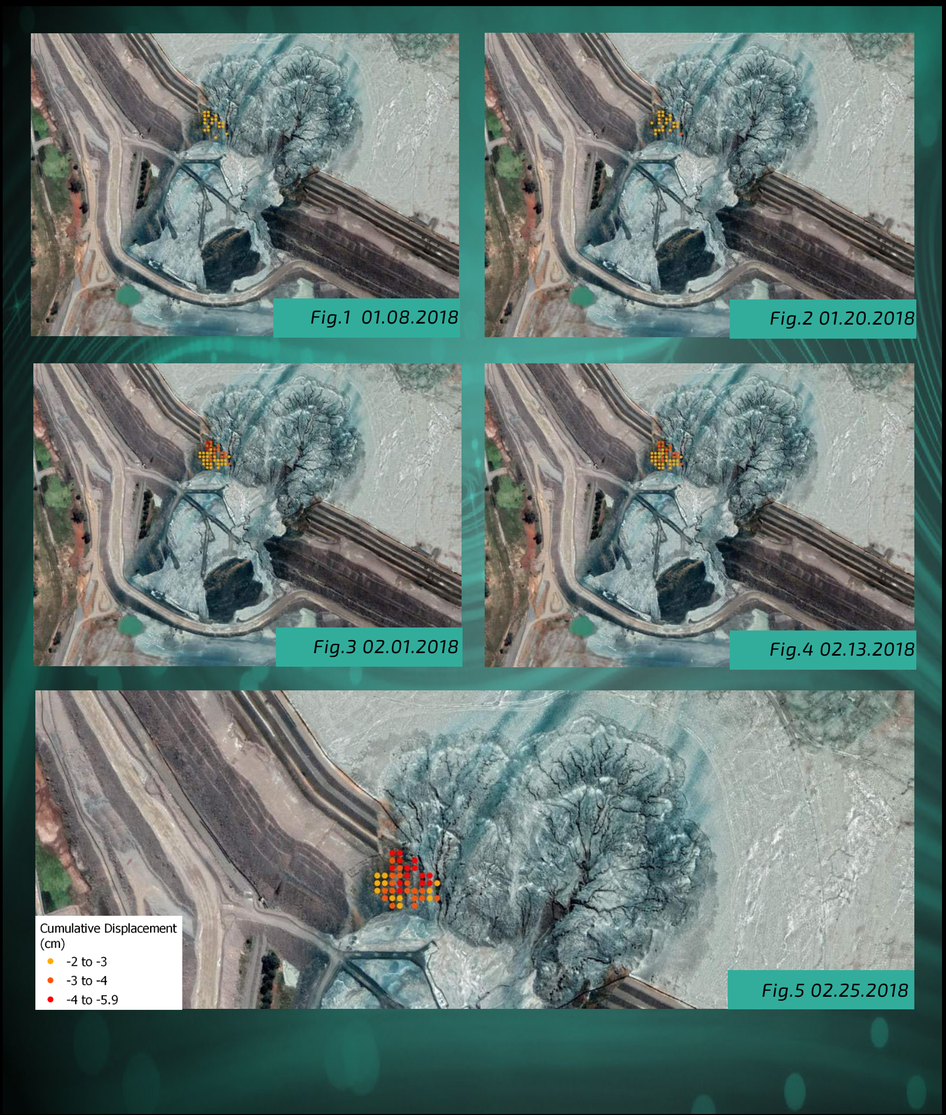
In our analysis, we identified signs more than two months before. On 8 January 2018 (Fig.1), a cluster of negative displacement points of -2cm to -3cm were detectable at that critical point of weakness in the wall. Twelve days later (Fig.2), there's an increase in both volume and speed of movement with -3cm to -4cm displacement beginning to emerge.

The trend continues at the start of February (Fig.3) with a spread of accelerated movement and by middle of the month (Fig.4) the magnitude of movement had increased to -4cm to -5.9cm.

This change in magnitude is notable in comparison to previous Mine Shift examples - where incremental displacement occurred over long periods of time – and underlines the role InSAR can play in augmenting routine physical inspection cycles.

Always on, always vigilant, CATALYST remote sensing and earth observation solutions can be trained on mining sites ready to spot noteworthy movements in tailings dam structures.

Displacement events like those at Cadia shouldn't be a surprise in 2023, nor for any mine of the future, because they are detectable, and they are preventable when even the slightest shift can be identified as soon as it appears.



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The value of this analysis

The intent of our analysis, and indeed of earth observation in general, is to highlight how the sensitivity to ground changes can be used as an early warning indicator of areas that require more monitoring.

Satellite-based change analysis coupled with in situ ground monitoring equipment and surveying can be used as an effective risk reduction solution.

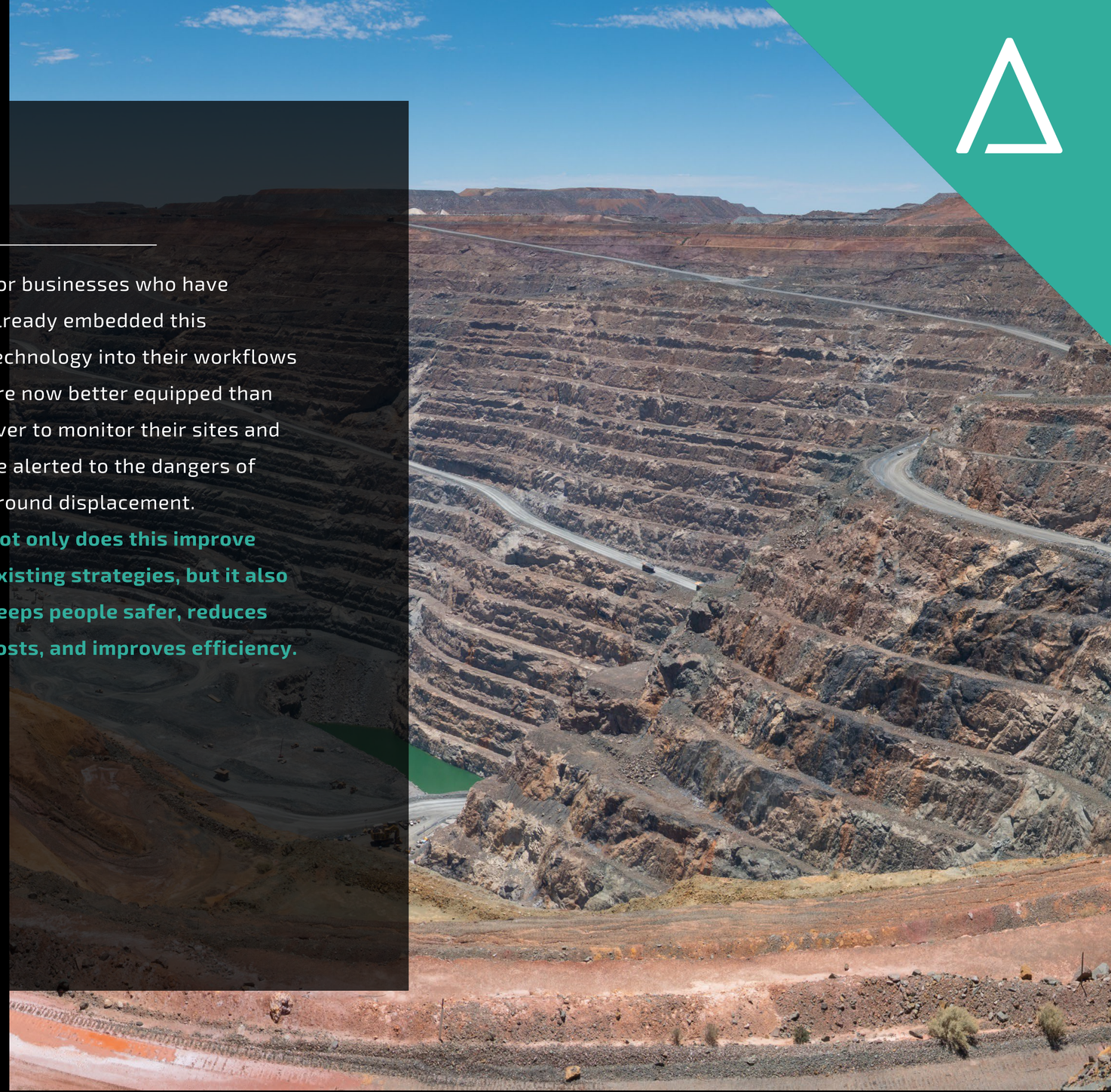
Significant structural failures, breaches or collapses can occur suddenly, and they can have both catastrophic human and economic impact.

Traditional monitoring, maintenance, and risk mitigation strategies play a key role in preventing them, but they have their limitations, including operational costs and the potential safety of the maintenance teams.

Earth observation harnesses the power of satellites to conduct regular monitoring of critical sites, with near-real time data delivery, which is perfect for maintenance teams to augment existing strategies at much lower cost than intermittent manual checks.

For businesses who have already embedded this technology into their workflows are now better equipped than ever to monitor their sites and be alerted to the dangers of ground displacement.

Not only does this improve existing strategies, but it also keeps people safer, reduces costs, and improves efficiency.



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From exploration to decommissioning:
CATALYST analysis supports each stage of the mining lifecycle

Exploration & Discovery

Leverage satellite imagery to map lineaments, plan access routes through terrain analysis and assessment of land cover types.

Tailings Dam

Reduce your dependency on conventional surveying to measure surface displacement and horizontal slips for tailings dams of any size.

Slope & Bench Stability

Keep your personnel and equipment safe by monitoring ground displacement, a common precursor to slope failure.

Deep-mine Surface Monitoring

Identify risks to surface infrastructure and assets due to subsidence caused by underground mining operations.

Decommissioning

Apply multi-temporal analytics using repeat pass satellite imagery to quantify vegetation growth, water conditions and habitats.

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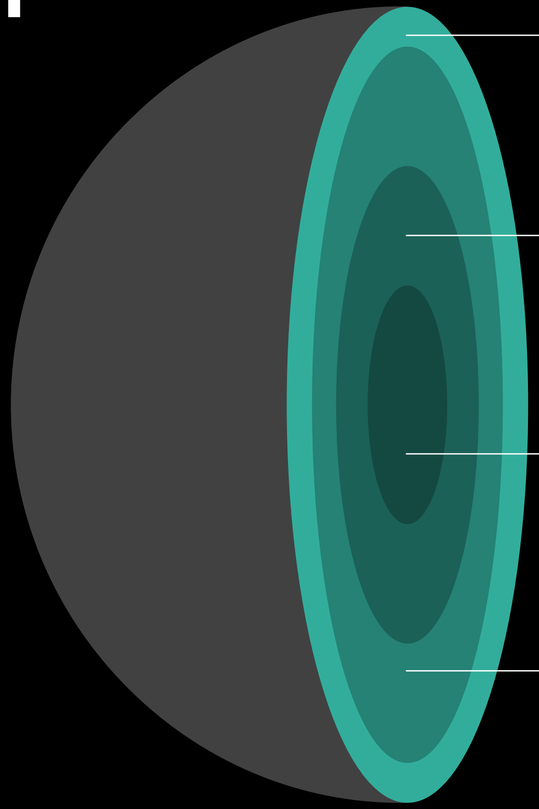
Discover what CATALYST can do for you



Earth observation and analytics is no longer a tool for the specialists.

Thanks to our cloud-based innovations. CATALYST solutions are available to all businesses, teams, and decision makers.

Integrated seamlessly into your workflows without the need for technology upgrades, they can have an immediate transformative impact on your strategies and outcomes.

Discover what they can do for you.
Get in touch with our team today.

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References

[1] Cadia Gold Mine - another tailings dam failure - The Landslide Blog - AGU Blogosphere

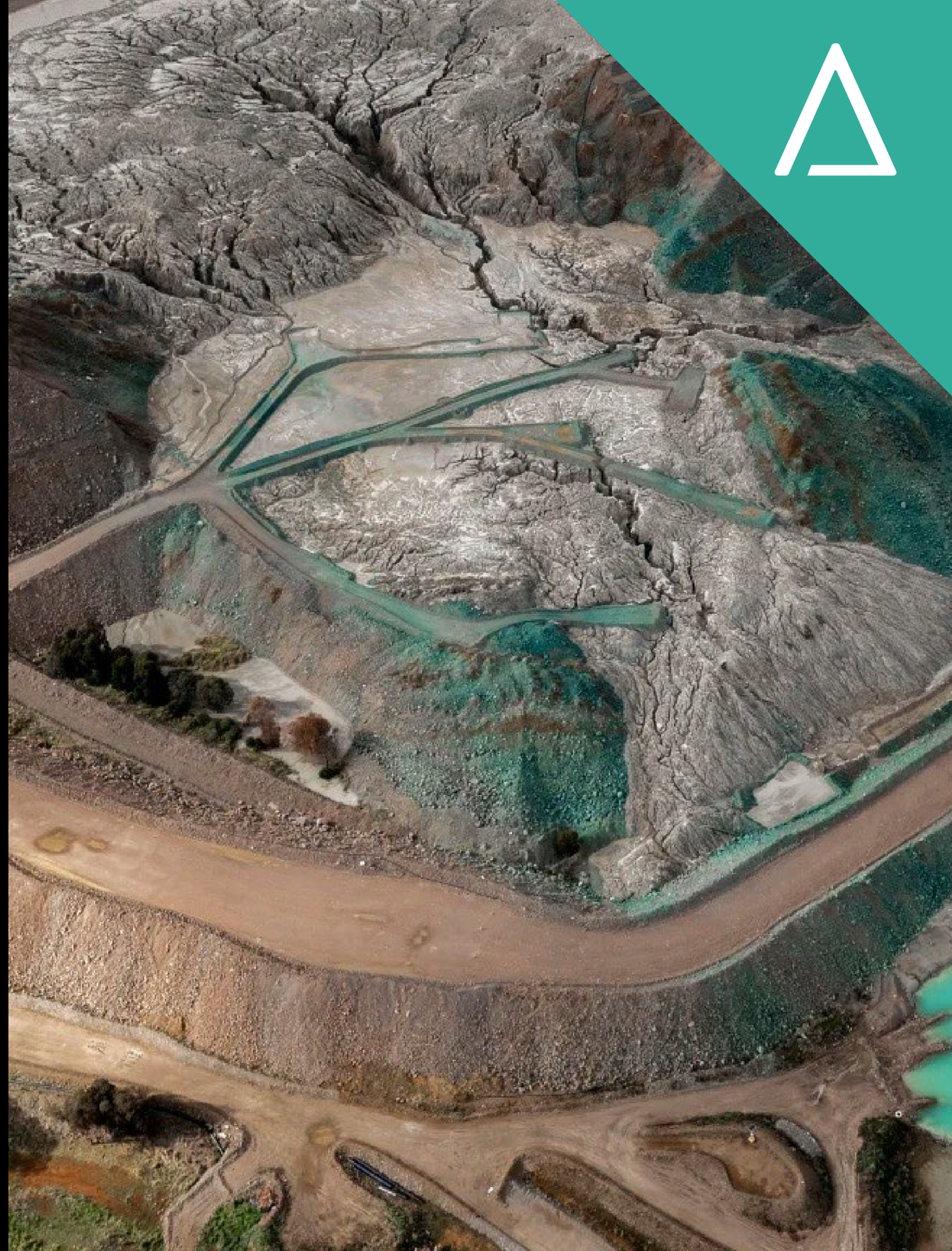
[2] Inside Cadia, the NSW goldmine at the centre of an environmental dust-up | Australia news | The Guardian

[3] EPA launches criminal proceedings against Newcrest's Cadia gold mine for alleged air pollution - ABC News

[4] https://www.amsj.com.au/newcrest-report-into-cadia-tailings-dam-failure-released/

Newcrest Parliamentary Response

We recognise the ongoing legal proceedings and Newcrest's recent Parliamentary Inquiry Response, which is available to read here.

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