

Presentation of the UN Environment Rapid Response Assessment on Tailings dams storage facilities

By Elaine Baker, Charles Roche & Kristina Thygesen

Geological Resources & Ocean Governance Group

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MINE TAILINGS STORAGE: SAFETY IS NO ACCIDENT

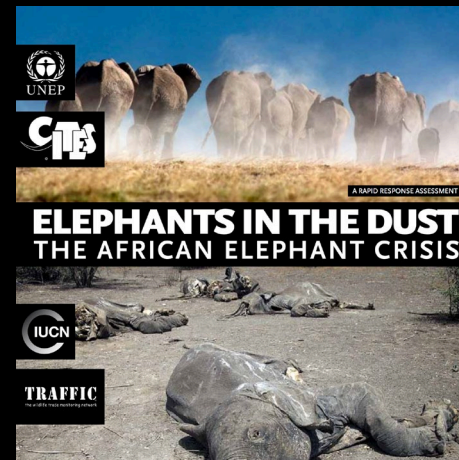
A RAPID RESPONSE ASSESSMENT



The aim of Rapid Response Assessments

The UN Environment reports are designed to:

1. shine light on an issue
2. gather and visualise information and catalyse research
3. develop recommendations for actions

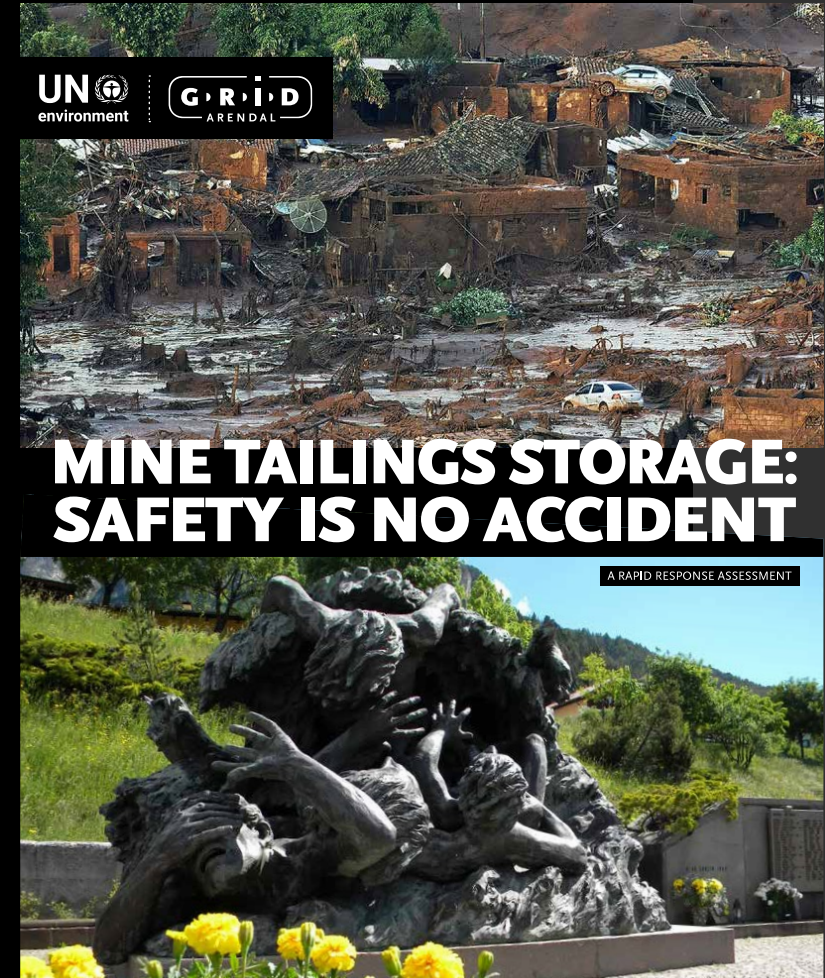


More RRA's can be accessed here: <http://www.grida.no/publications>

The Rapid Response Assessment

The report was motivated by community concerns, and acknowledges the human and environmental costs of continued tailings dam disasters.

The report informs a wider audience of the consequences of failure and importantly, the **OPPORTUNITIES** to reduce risk and improve safety of tailings storage.

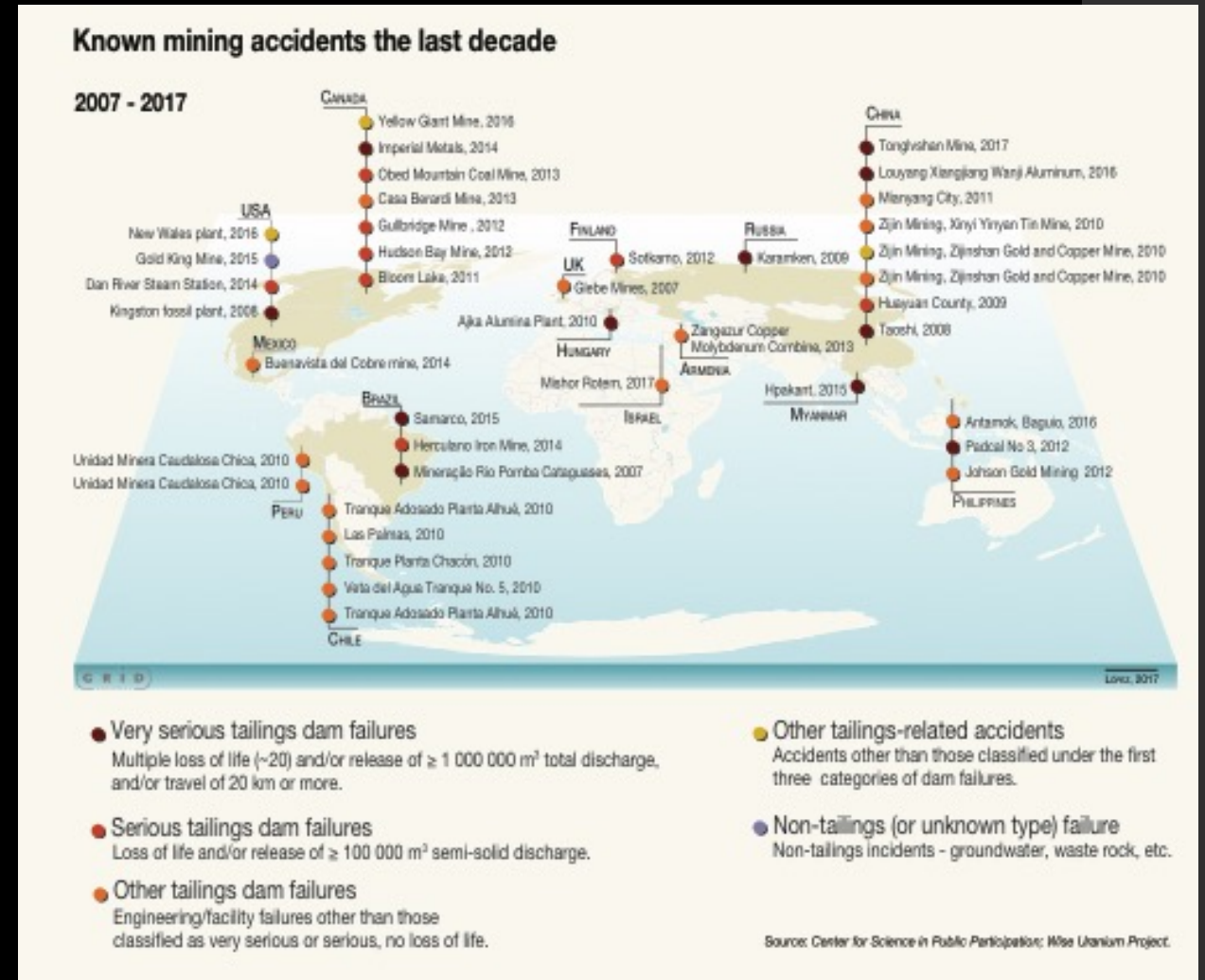


This Rapid Response Assessment

This report provides an overview of the **KEY ISSUES** surrounding tailings dam failures.

It uses case studies to illustrate:

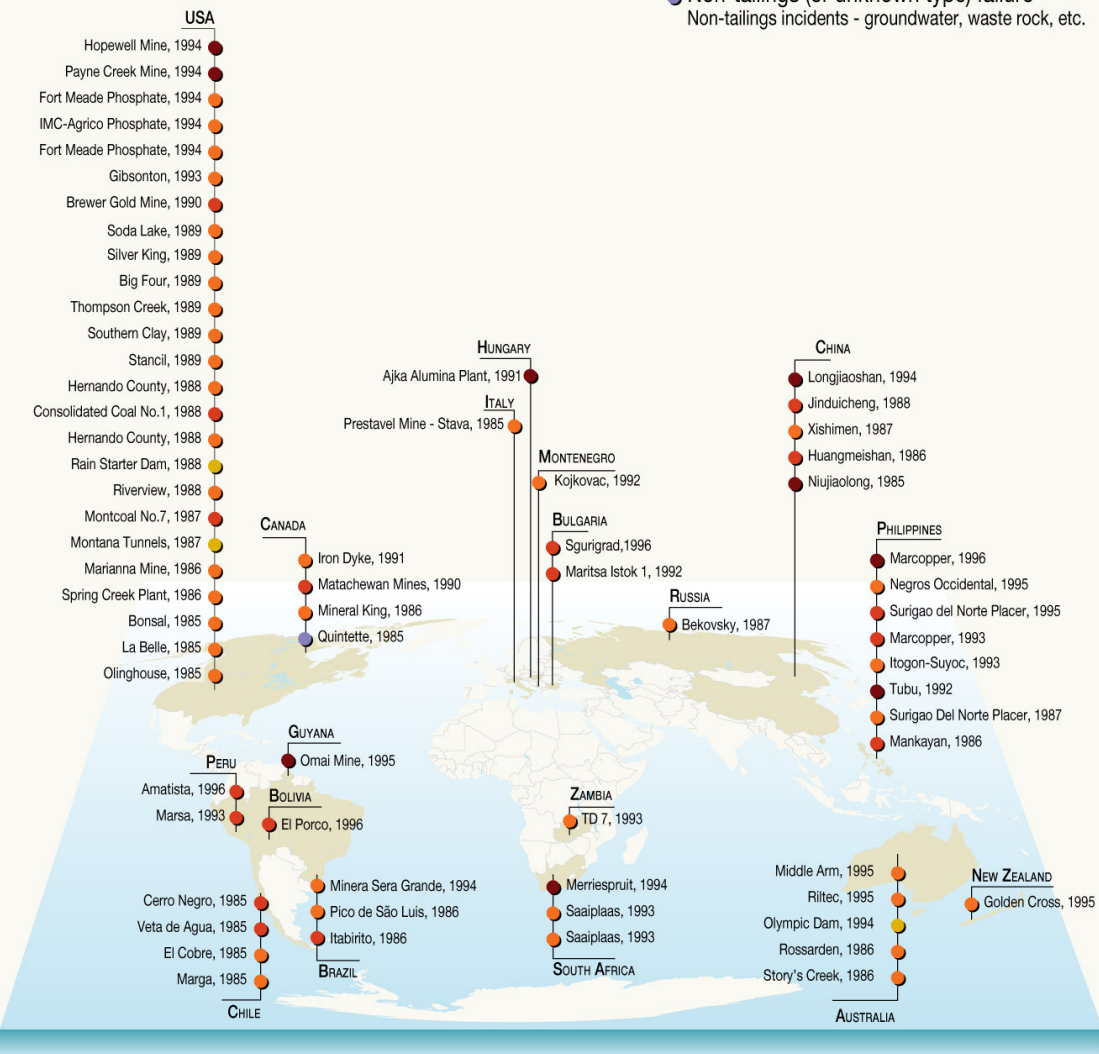
- causes of failure and
- direct and long-term consequences for the people and the environment



Known mining accidents

- Very serious tailings dam failures
Multiple loss of life (~20) and/or release of ≥ 1 000 000 m³ total discharge, and/or travel of 20 km or more.
- Serious tailings dam failures
Loss of life and/or release of ≥ 100 000 m³ semi-solid discharge.
- Other tailings dam failures
Engineering/facility failures other than those classified as very serious or serious, no loss of life.
- Other tailings-related accidents
Accidents other than those classified under the first three categories of dam failures.
- Non-tailings (or unknown type) failure
Non-tailings incidents - groundwater, waste rock, etc.

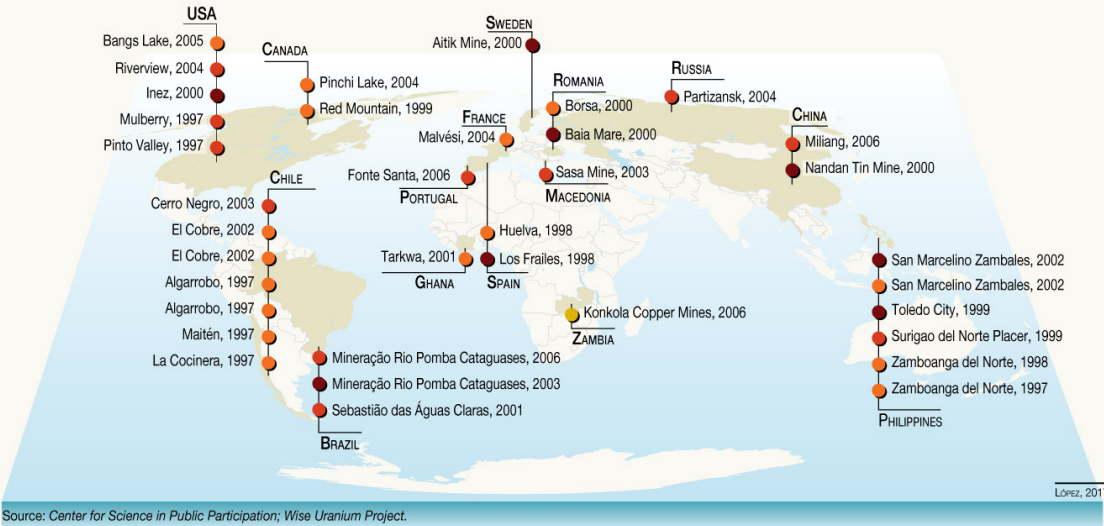
1985-1996



2007 - 2017

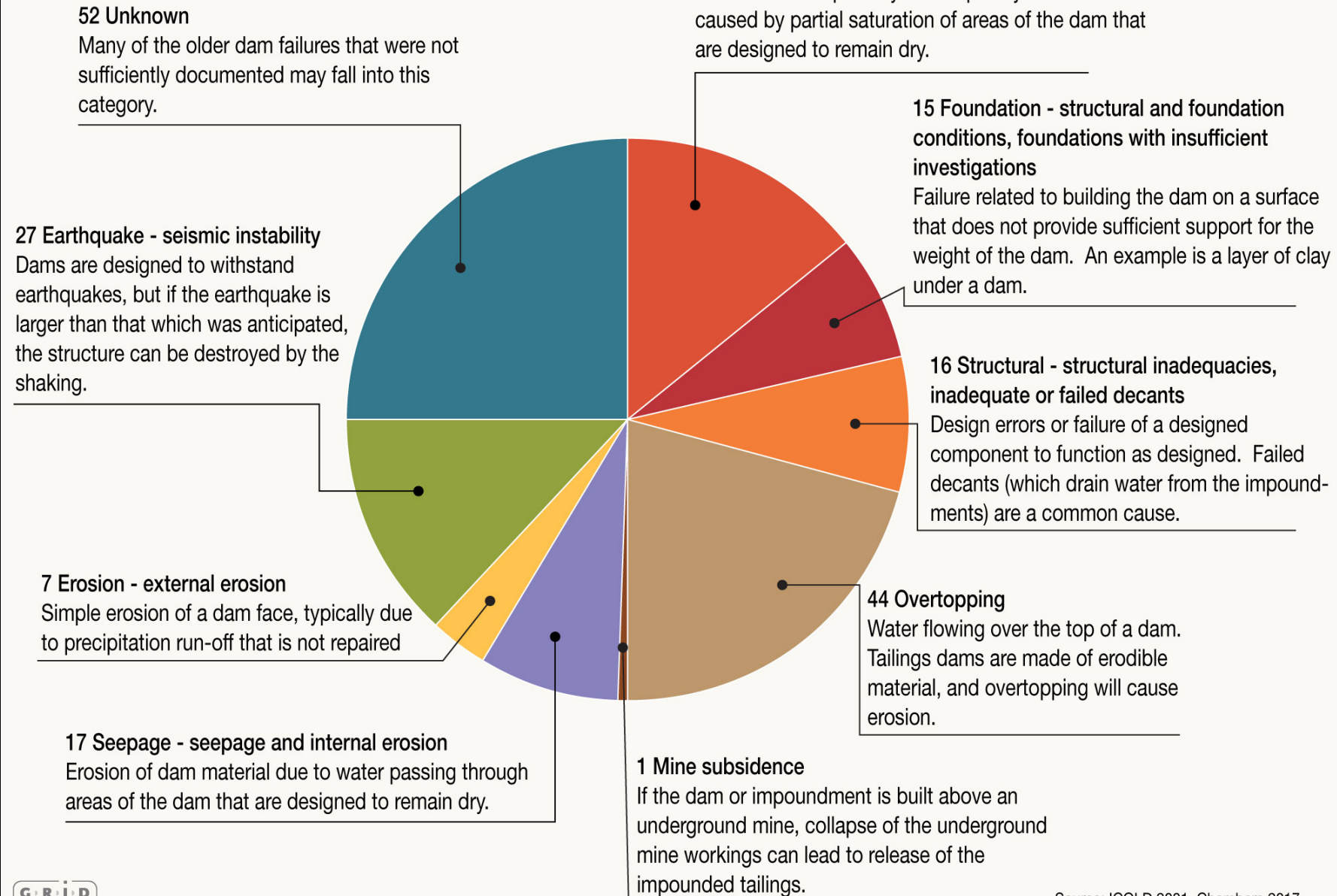


1997-2006



Source: Center for Science in Public Participation; Wise Uranium Project.

Causes of tailing dams failures 1915-2016

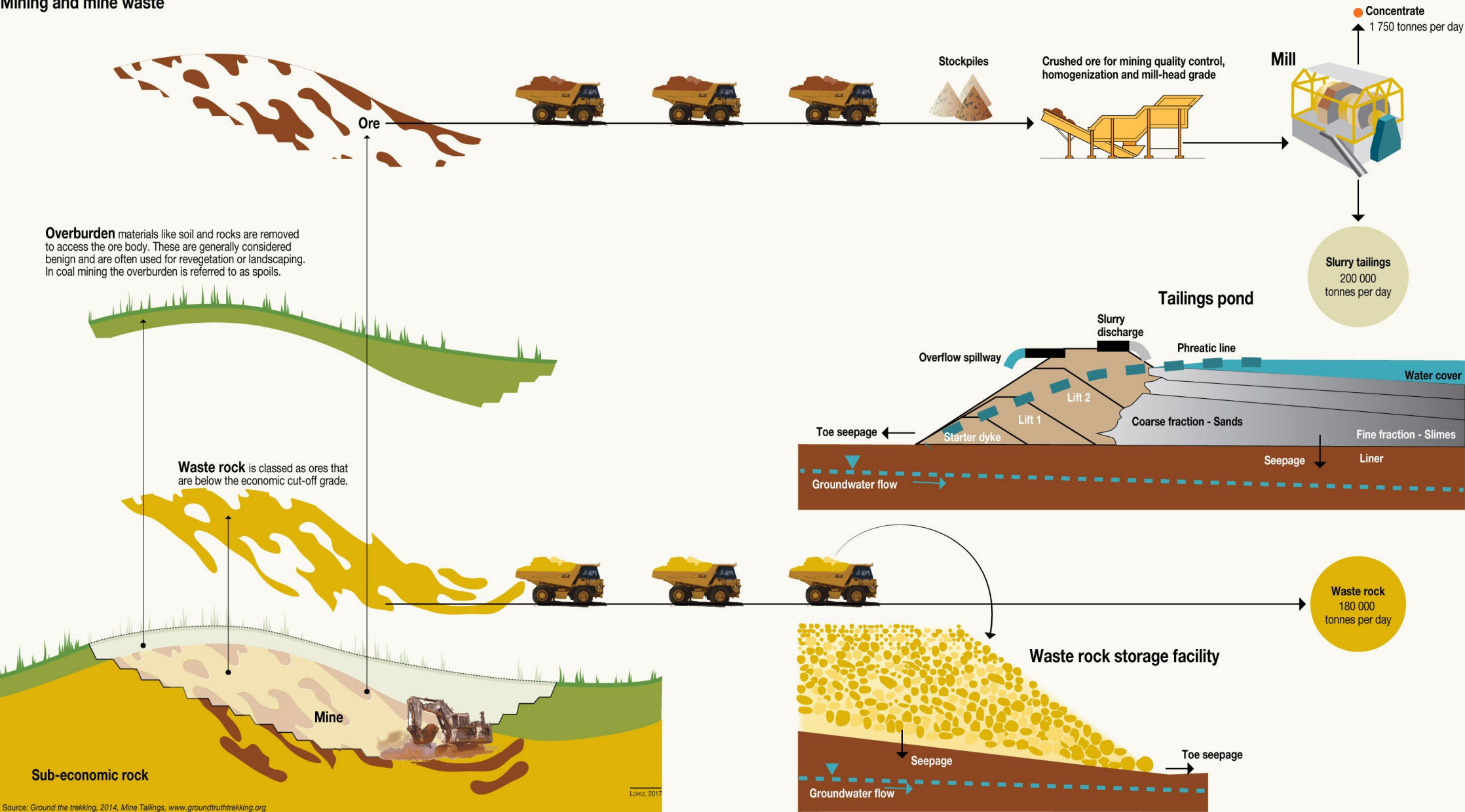


Tailings Dams – size



The Fort Knox gold mine in Alaska. The tailings are contained in a valley behind an earth and rock embankment that creates a dam. This tailings storage facility is eventually expected to cover 395 hectares and store approximately 270 million tonnes of tailings.

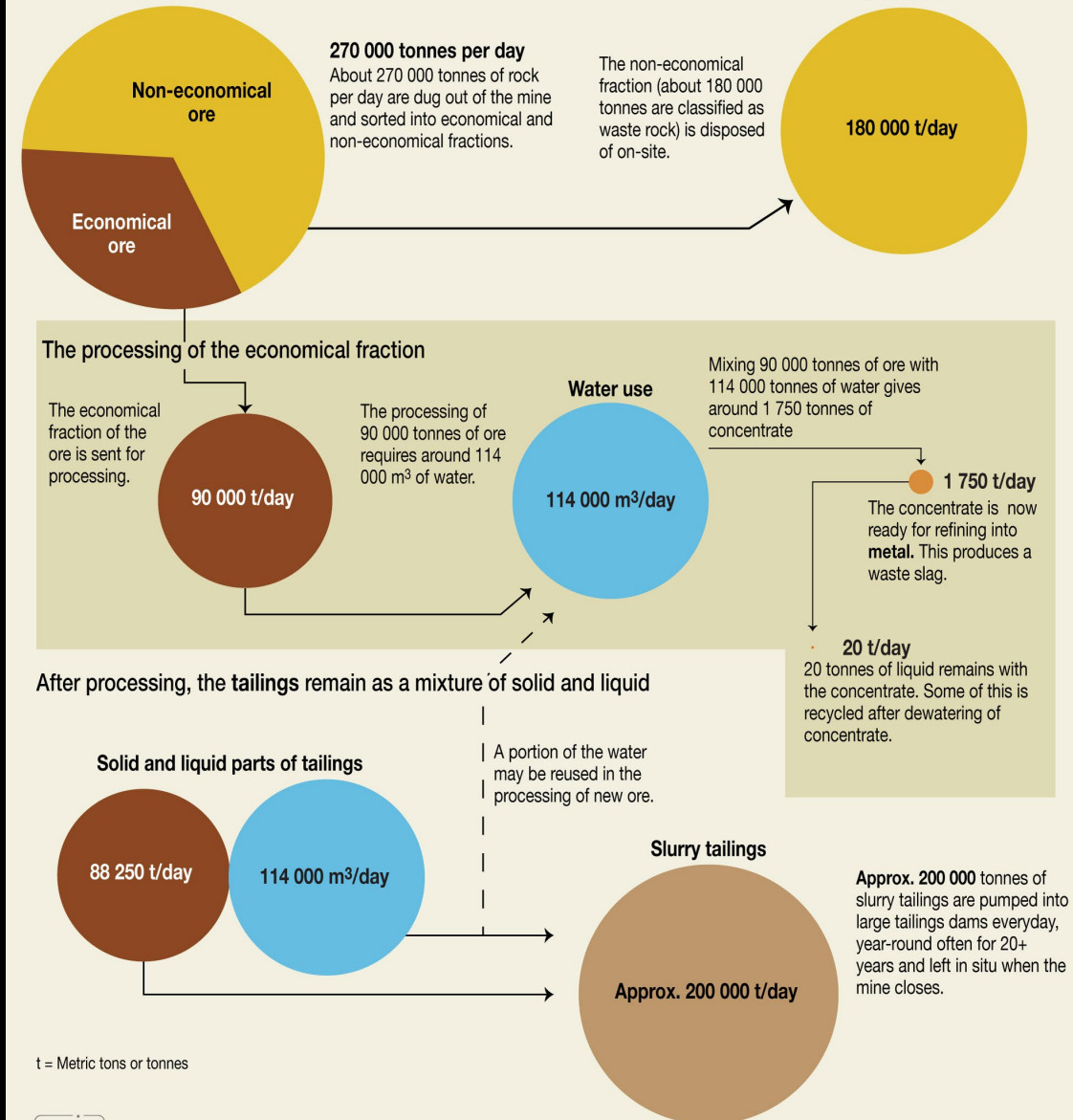
Mining and mine waste



Source: Ground the trekking, 2014, Mine Tailings, www.groundtruthtrekking.org

Not just waste

An average day in a large-sized copper mine



Samarco – Brazil 2015

5 November 2015, the Fundão dam breached, releasing an estimated 33 million m³ of mine waste slurry.

19 people were killed - village residents and Samarco employees.

The slurry reached the Doce River Valley and travelled for 665 km until it reached the Atlantic coast 14 days later.



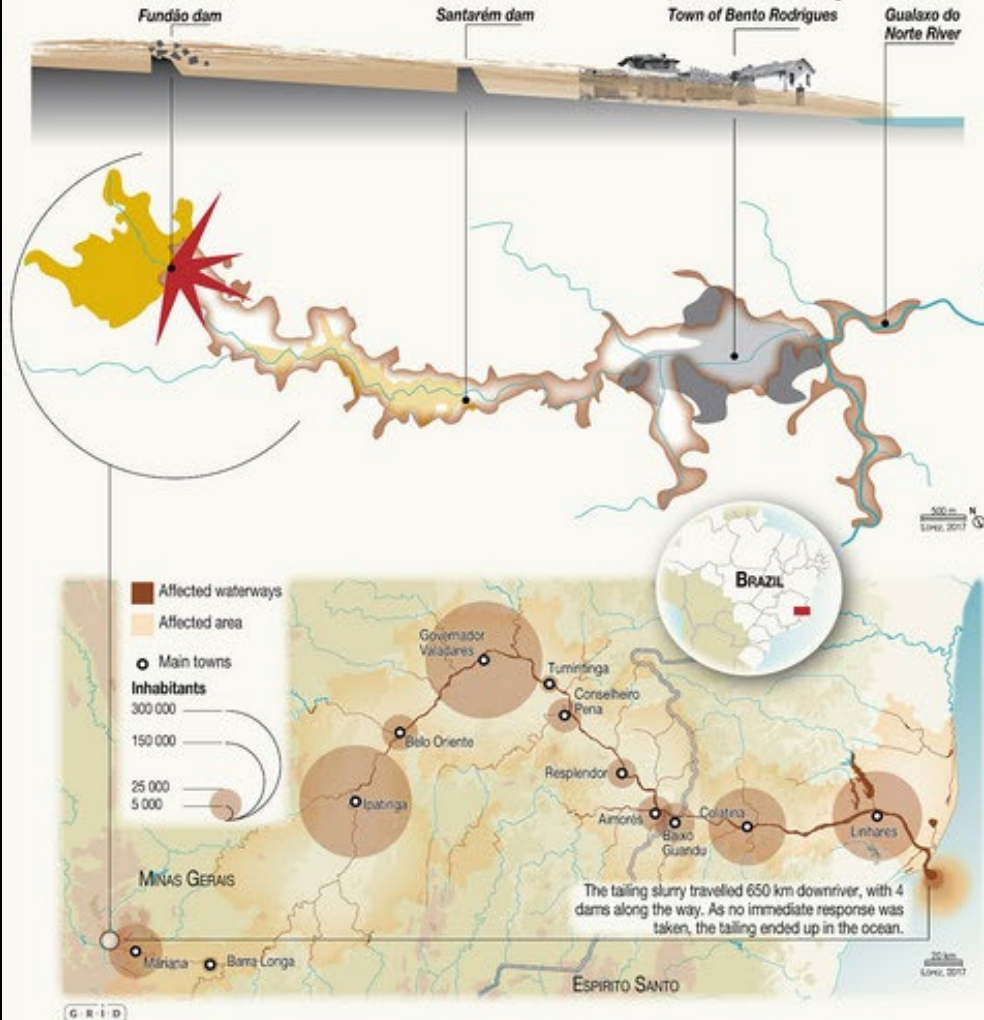
Samarco – Brazil 2015

Germano mine storage facility failure

The **Fundão** dam, one of the tailings dams at Germano mine, broke on the afternoon of 5 November 2015. The breach discharged 33 million m³ of iron ore tailings slurry.

Initially it was believed that the **Santarém** dam had also broken, but later it was verified that the mud from the Fundão dam had covered it, causing it to overflow as well.

The mud devastated the sub-district of **Bento Rodrigues**, pulling vehicles downstream and destroying hundreds of houses, following the **Gualaxo** and **Doce** rivers affecting the municipalities of Minas Gerais and Espírito Santo before reaching the Atlantic Ocean.



Direct impacts

PEOPLE

19 people died, 600 families were displaced and at least 400 000 people had their water supply disrupted.

FAUNA

Entire fish populations- at least 11 tons- were killed immediately when the slurry buried them or clogged their gills.

HERITAGE

Numerous colonial monuments dating back to the 1700s were destroyed.

INFRASTRUCTURE

The slurry filled 650 km of hydrologic networks.

VEGETATION

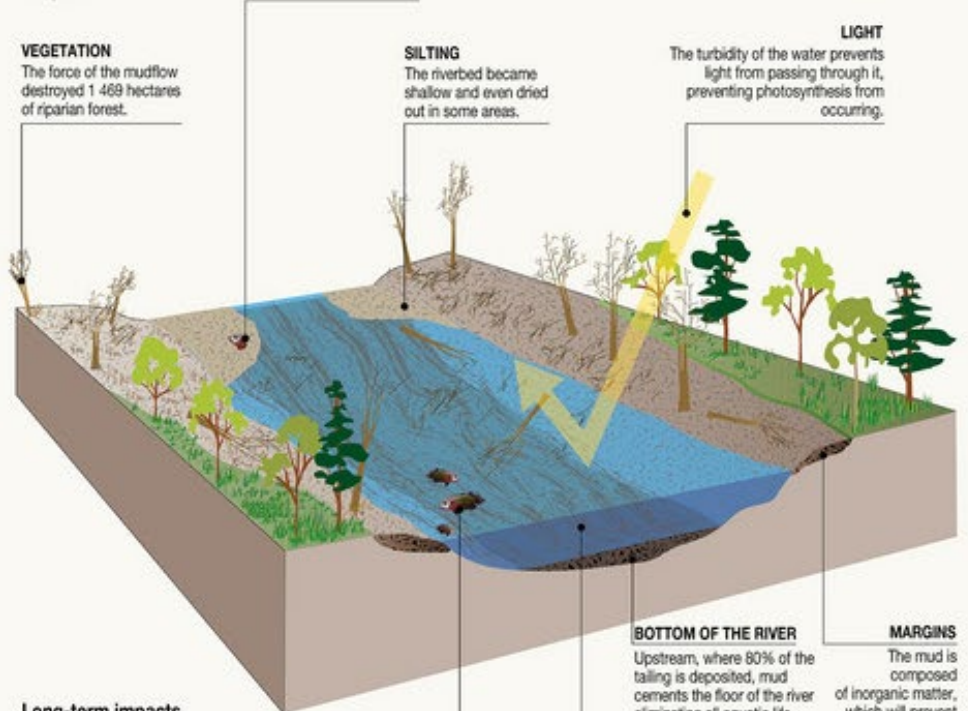
The force of the mudflow destroyed 1 469 hectares of riparian forest.

SILTING

The riverbed became shallow and even dried out in some areas.

LIGHT

The turbidity of the water prevents light from passing through it, preventing photosynthesis from occurring.



Long-term impacts

PEOPLE

The destruction of riparian, freshwater and marine ecosystems eliminated irreplaceable natural resources and ecological processes that support traditional livelihoods, disrupting fisheries, agriculture, tourism and freshwater resources. The interruption of the mining activity will severely affect the local economies of 37 villages and cities. Fishing and agriculture are banned across affected areas for an indefinite period and misguided future use and restoration designs may increase human exposure to heavy metals.

pH AND TEMPERATURE

The sediment altered the acidity and the temperature of the water, killing aquatic life.

TURBIDITY

Downstream and close to the river mouth, when the river level rises after the rainy season, turbidity increases and metal levels in the water column return to the same level as in November 2015.

BOTTOM OF THE RIVER

Upstream, where 80% of the tailing is deposited, mud cements the floor of the river eliminating all aquatic life.

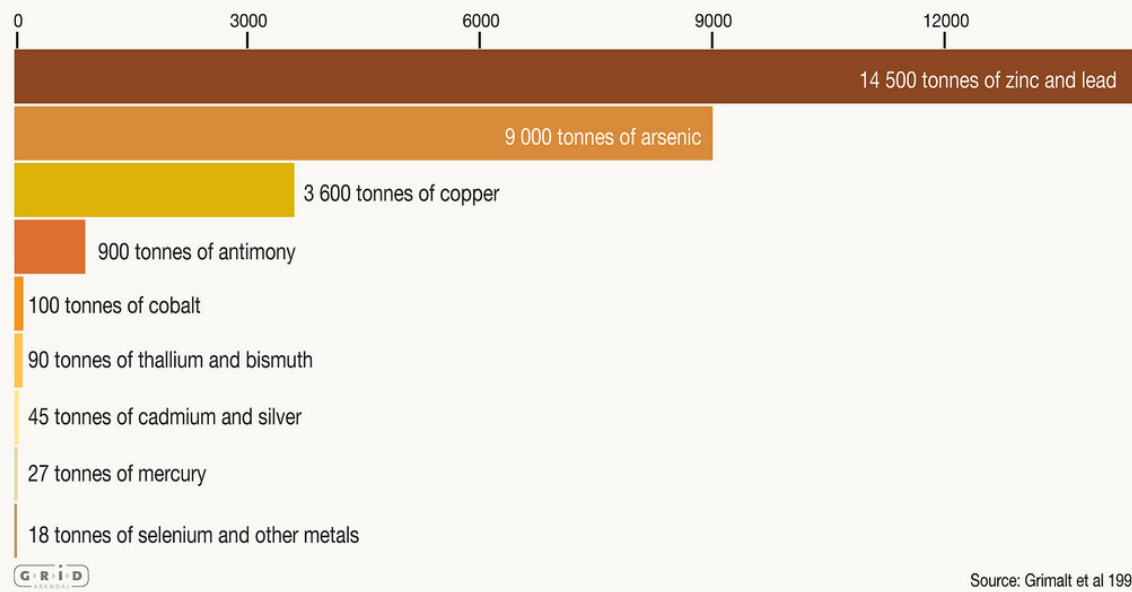
MARGINS

The mud is composed of inorganic matter, which will prevent plants from growing where it has settled.

Sources: Geraque E. et al. 2015, Rastro de lama, Folha de São Paulo; Costa C., 2015, O que já se sabe sobre impacto da lama de Mariana?, BBC Brasil; Fernandes, G.W. et al. 2016, Deep into the mud: ecological and socio-economic impacts of the dam breach in Mariana Brazil, *Natureza & Conservação*, n. 14, pp. 35-45; IBGE, 2017, Cidades. População, ibge.gov.br; Alzer Bastos Universidade Federal do Espírito Santo, Brazil.

Aznalcóllar, Spain 1998

Estimated amount of metals released into the environment

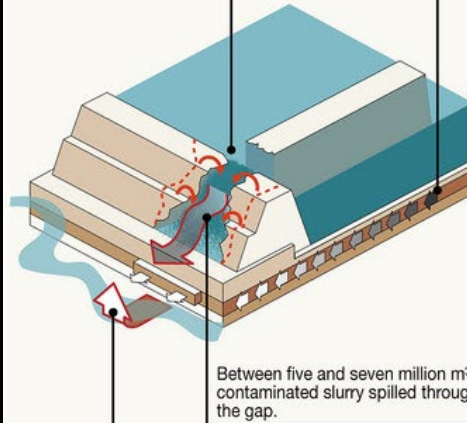


It released approximately 5.5 million cubic metres of acidic, metal-rich water and approximately 1.3 to 1.9 million cubic metres of toxic tailings into the Agrio, Guadiamar and Los Frailes Rivers

Aznalcóllar mine storage facility failure

A slab of soil beneath the dam slid approximately one metre towards the Río Agrio. The front of the slide was about 20 metres wide, and it was located in the area of the junction of the two impoundments.

The dam cracked and broke.



This caused the bed of the Río Agrio to rise locally by three metres.

- Parks designed after tailings spill
- Parks present at time of tailings spill
- Location of Los Frailes tailings spill
- Area of spill

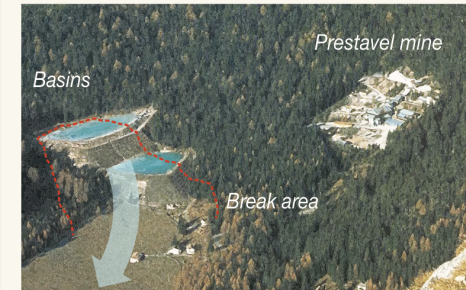


Stava Italy 1985

In July 1985, the tailings dam of the Prestavel fluorite mine collapsed, causing the deaths of 268 people.

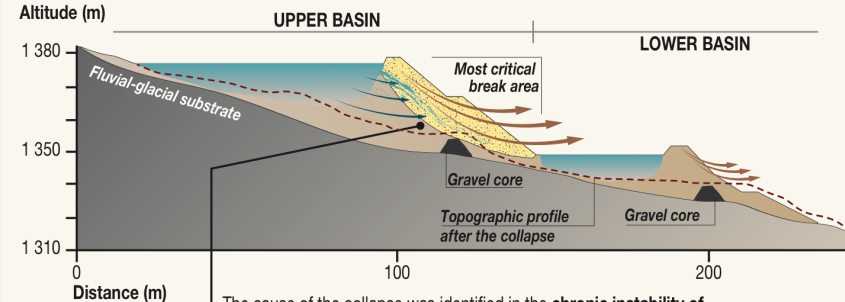
Around 180 000 m³ of semi-fluid tailings were released, burying the downstream villages of Stava and Tesero.

Val di Stava dam collapse



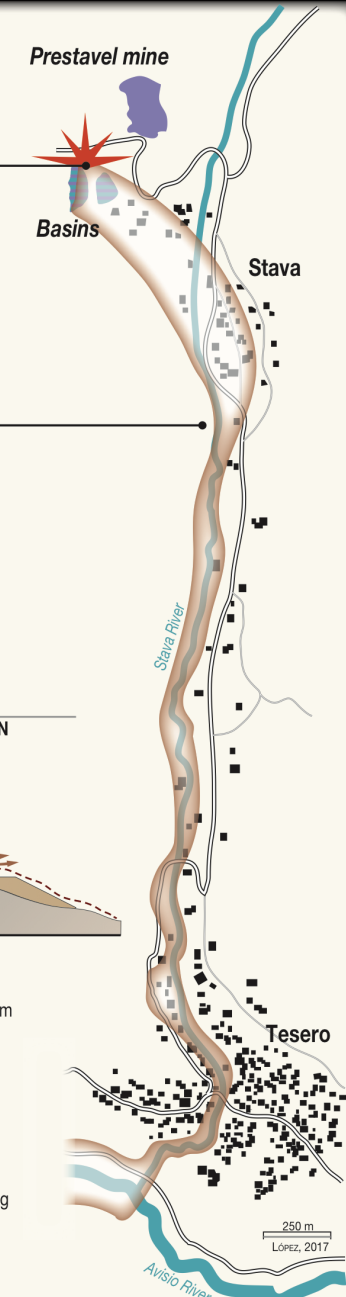
In July 1985, the embankment of the upper decanting basin dropped, causing the collapse of the lower one as well. This released a mass of about **180 000 m³ of water and mud pouring** at a speed of about 90 km/h in the valley below. Along the route, another 40 000-50 000 m³ of erosion caused the destruction of buildings and hundreds of trees.

Mudflow caused the **death of 268 people** (including 59 under-18s), the complete destruction of 3 hotels, 53 houses, 6 sheds and hundreds of trees. In addition, 8 bridges and 9 heavily damaged buildings were demolished. A **layer of mud between 20 and 40 cm thick** covered an area of approximately **435 000 m²** for a length of 4.2 km.



The cause of the collapse was identified in the **chronic instability of landfills**, and in particular the upper basin, which did not have the minimum safety coefficients needed to avoid the collapse. In over 20 years, landfills were never subjected to a series of stability checks. Among others, the causes of instability have been identified in:

- the humid nature of the soil, which did not enable sludge drainage;
- the incorrect construction of the upper reservoir embankment and in the proximity to the lower one;
- the excessive height (34 m) and slope (up to 40°) of the embankment;
- the incorrect location and maintenance of the overflow pipes of decanting waters.



Stava – Italy 1985

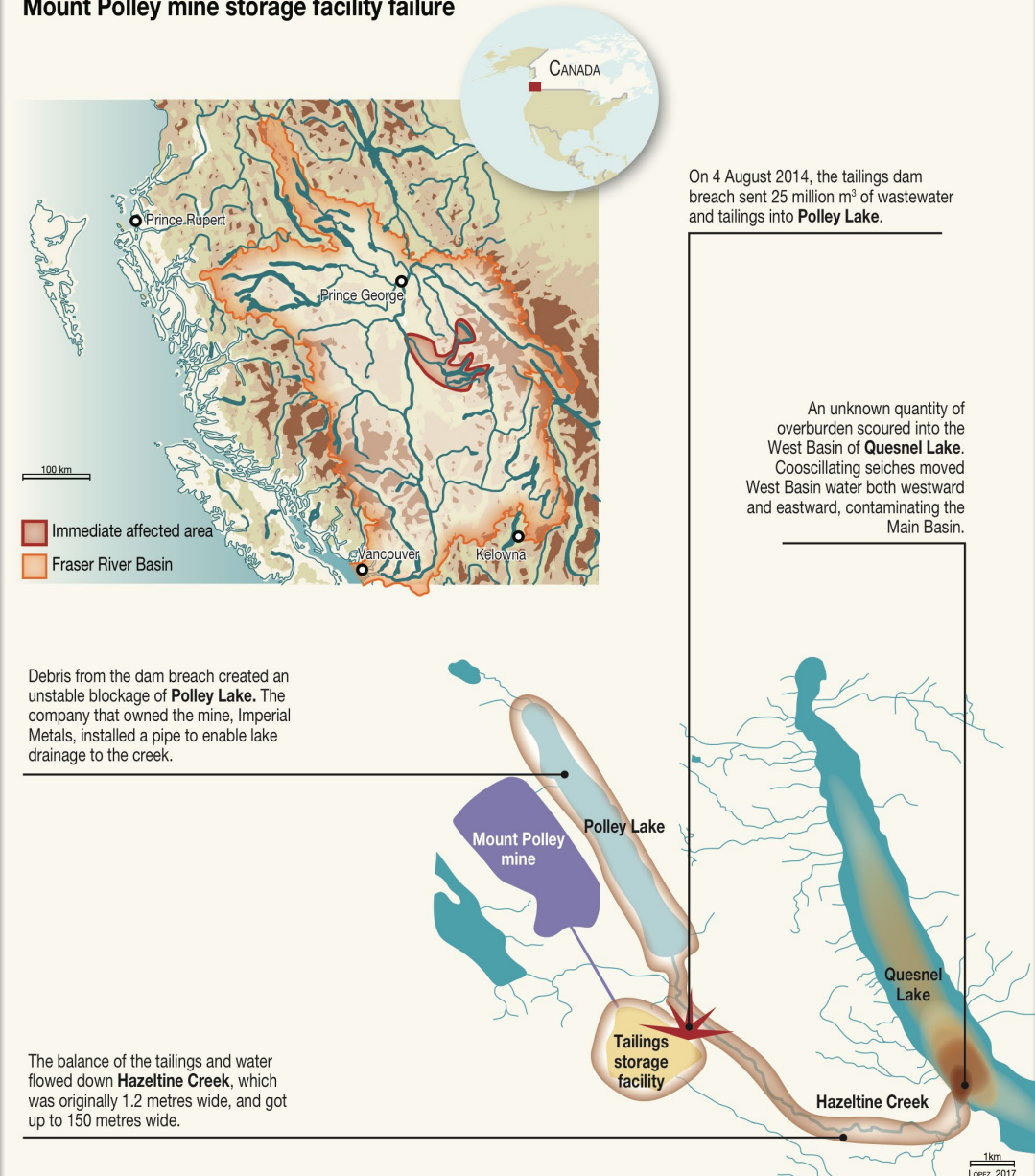


Cariboo

Canada 2014

- major mining nation

Mount Polley mine storage facility failure

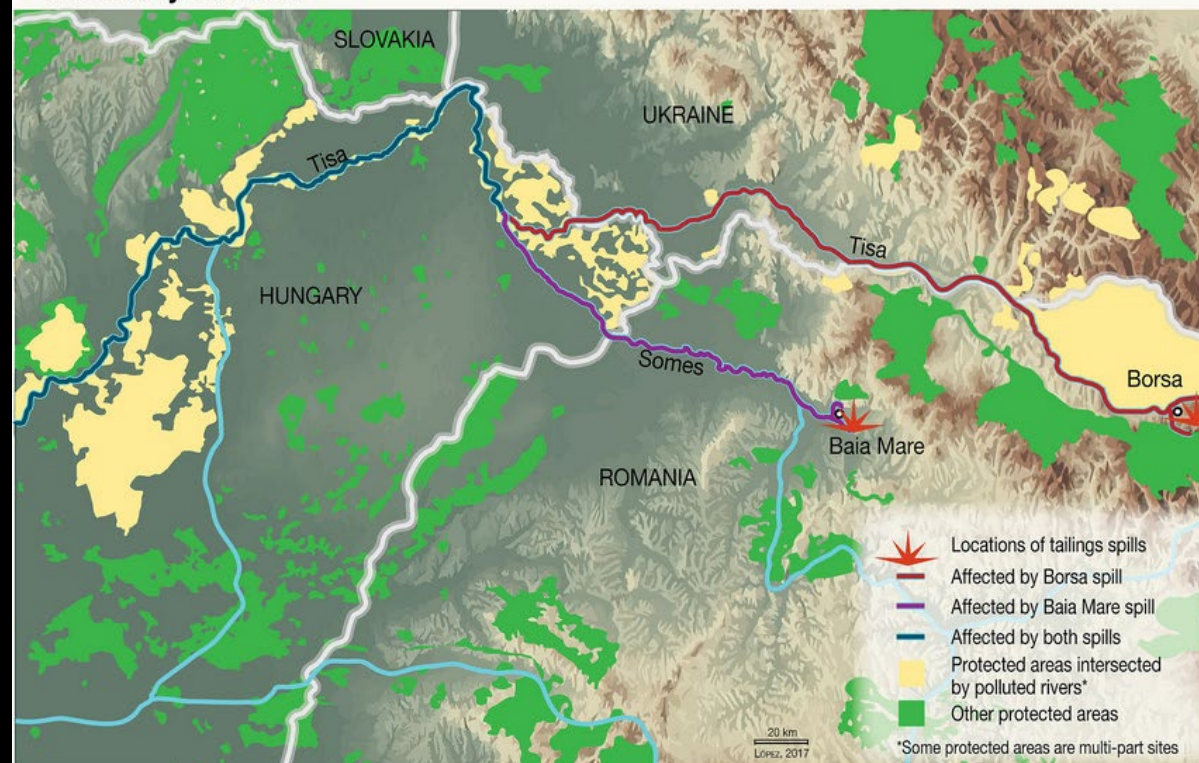


Maramures County

Romania, 2000

- Cumulative
 - Baia Mare – gold
 - Borsa - Zink
- Transboundary

Case study: Romania



Progress of the spill plume

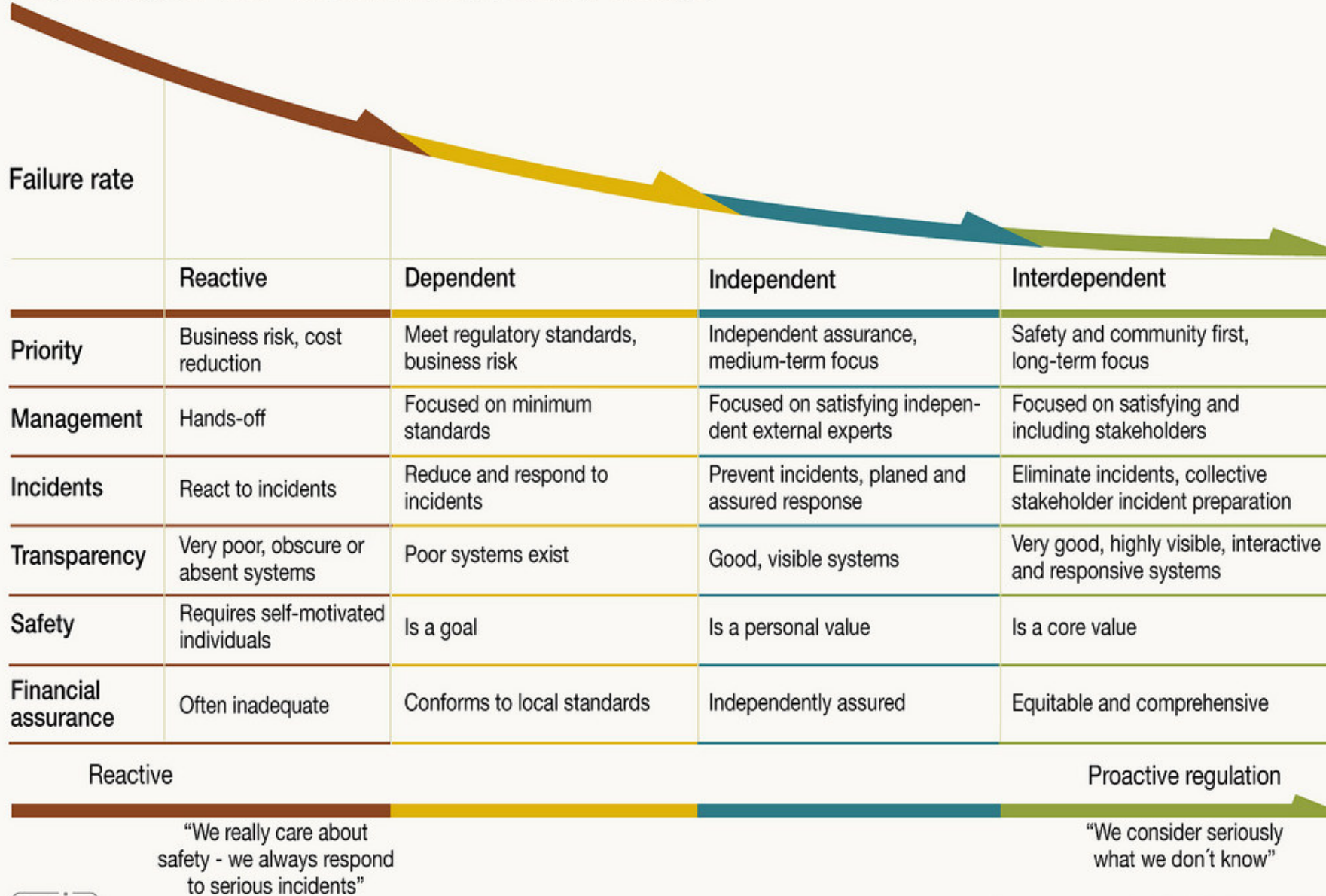
- 30 January**
Cyanide spill occurs at Baia Mare, Romania
- 1 February**
Spill plume reaches Romanian-Hungarian border
- 5 February**
Cyanide registers in tests at Tiszalök
- 9 February**
Spill plume reaches Szolnok
- 11 February**
It crosses the Hungarian-Yugoslavian border
- 13 February**
It reaches Belgrade (Perlez), Yugoslavia
- 15 February**
It meets the Romanian border again, at Ram
- 17 February**
Cyanide registers in tests at Iron Gate, Romania
- 25-28 February**
The plume reaches the Danube Delta



The challenge

- Tailings dams are increasing in number and size
- Consequences of failure, the disproportionate impact on indigenous and poor communities.
- These risks present a challenge for this generation, now. And if not addressed, will be a debt we leave to future generations.
- Opportunities to reduce risk and improve safety.
- Industry and regulators have been aware of the challenge of safe tailings storage for many years. New process, management strategies, industry guidelines and a commitment to safety resulted in a reduction of catastrophic failures.
- We need to build on these successes.

Regulating for risk - implementing positive change



Recommendations – the way forward

Recommendation 1

The approach to tailings storage facilities must place safety first by making environmental and human safety a priority in management actions and on-the-ground operations. Regulators, industry and communities should adopt a shared zero-failure objective to tailings storage facilities where “safety attributes should be evaluated separately from economic considerations, and cost should not be the determining factor” (Mount Polley expert panel, 2015, p. 125)

Recommendation 2

Establish a UN Environment stakeholder forum to facilitate international strengthening of tailings dam regulation.

Actions - knowledge

Knowledge,
technology,
innovation &
people

- ▶ **Establish** an accessible public-interest, global database of mine sites, tailings storage facilities and research.
- ▶ **Fund** research into mine tailings storage failures and management of active, inactive and abandoned mine sites.
- ▶ **Compile** and review existing regulations and best practice guidance.
- ▶ **Encourage** innovation in the reuse and recycling of mine tailings.
- ▶ **Encourage** the development of technological solutions to eliminate the main causes of failures.

Benefits

- ▶ **Establishes** a basis for improved regulation and consistent best practice.
- ▶ **Assists** in educating people to make informed decisions.
- ▶ **Reduces** the volume of tailings stored and potentially creates additional business opportunities.
- ▶ **The path** to zero failures (IEEIRP 2015).

Actions – failure prevention

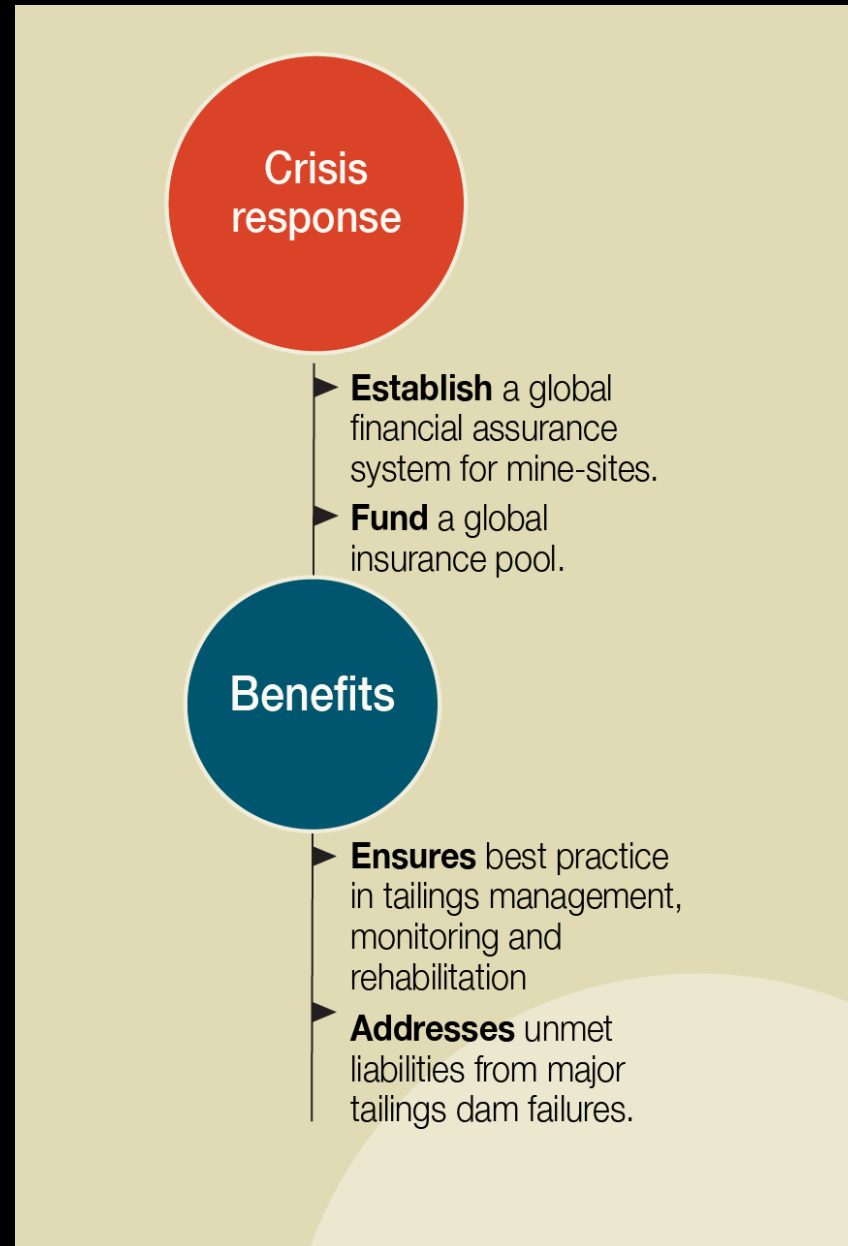
Failure prevention

- ▶ **Expand** mining regulations to include independent monitoring and the enforcement of financial and criminal sanctions for non-compliance.
- ▶ **Regularly** publish disaster management plans.
- ▶ **Increase** gender diversity and broaden skill sets on company boards.
- ▶ **Establish** independent waste review boards to conduct and publish independent technical reviews prior to, during construction or modification, and throughout the lifespan of tailings storage facilities.
- ▶ **Avoid** dam construction methods known to be high risk.
- ▶ **Ensure** any project assessment or expansion publishes all externalized costs, with an independent life-of-mine sustainability cost-benefit analysis.
- ▶ **Require** detailed and ongoing evaluations of potential failure modes, residual risks and perpetual management costs of tailings storage facilities.
- ▶ **Enforce** mandatory financial securities for life of the mine.
- ▶ **Ban or commit to avoid** riverine disposal and avoid submarine disposal unless justified by independent review.

Benefits

- ▶ **Clarifies** responsibility for tailings dam performance.
- ▶ **Provides** transparency on disaster planning.
- ▶ **Improves** governance and corporate social responsibility.
- ▶ **Reduces** risk of dam failure by providing independent expert oversight.
- ▶ **Reduces** risk of failure by eliminating less stable methods of dam construction.
- ▶ **Protects** the environment from less controlled waste disposal.

Actions – crisis response





Collective actions – zero failures

- Rethink our approach to tailings dams
- Long-term social assets and liabilities
- Integrative, interdependent approach
- Industry technical and management improvements
- Regulate for success

Recognising the reality of a cyclical global industry, co-operative, international action is the key to ensuring that all tailings dams are fit for purpose and the risks to local and downstream communities, sensitive environments and economics are reduced and managed until we reach our target of zero failures.