The Commonwealth

Natural Resource Insights

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Mine Tailings Management and Regulation: An Overview

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1. Introduction

This briefing note addresses an issue of critical importance in mineral development: the management of mining waste (known as 'tailings'). It is aimed at Commonwealth policymakers seeking a better understanding of mine tailings and the policy/regulatory options available for addressing related concerns. The document will cover the following: why the issue is important, the impact of tailings on communities, how the management of tailings is relevant to governments, the emergence of a global standard for tailings management and the role governments can play in promoting best practice.

2. Tailings: why is this an important issue?

Mine tailings are the waste material from mining operations after ore has been processed to extract the metals. The volume of tailings generated by mining can be large (e.g., 200,000 tonnes per day from one mine), in some cases even larger than the volume of the raw material produced from the mine (MMSD 2002).

Tailings are often stored as a liquid slurry in a specially constructed dam facility. Other options may include dry-stacking of de-watered tailings or back-filling open-pit mines. In a few countries, disposal may be made via rivers or the ocean, though this can have significant environmental implications that are difficult to predict or manage. In the future we may also see more efforts to re-mine tailings.

While the purpose of a tailings facility is to avoid the waste contaminating the water table, or otherwise impacting the environment, there is a risk of facility failure causing leaks. Indeed, on average worldwide, there have been at least three to four major incidents involving a tailings facility every year in the last 10 years (WISE Uranium Project 2022). Such major incidents have occurred in several Commonwealth member countries, including in Canada in October 2013 and August 2014, in Australia in March 2018, in South Africa in December 2021 and in India in April 2019 and, most recently, in January 2022 (ibid.).

> 'Worldwide, the metal content of copper ore has fallen by nearly half since the mid-20th century. Extracting a single kg of copper can now produce 200 kg of sludge [...] often contaminated with toxic metals or minerals that produce sulfuric acid when exposed to air.'
>
> Source: Cornwall 2020.

Estimates suggest the frequency of tailings incidents is increasing. Such failures can be catastrophic in terms of loss of human life, negative environmental impacts and other societal repercussions, such as

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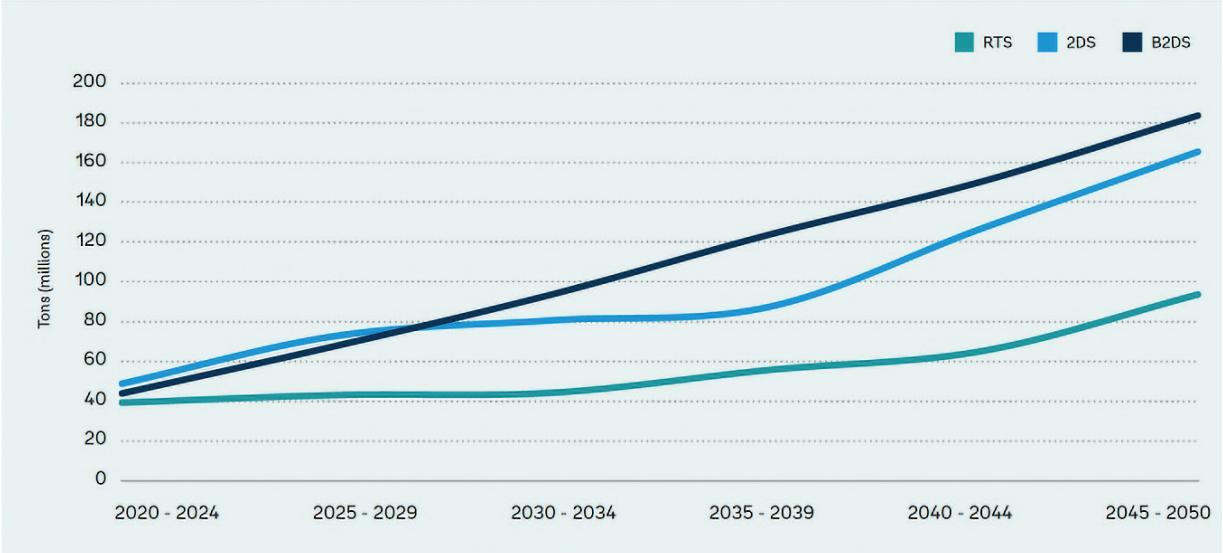
Tailings dam facility in British Colombia, Canada [photo credit: Garth Lenz]

On 25 January 2019, Vale's Brumadinho dam in Brazil failed, causing a 10-metre-tall wave of 10 million cubic metres of mining waste to wash over the Brazilian countryside at 120 km/hour with devastating results, including the loss of 270 lives.

loss of farmlands. There may also be other, slower-onset environmental risks such as the contamination of surface or groundwaters or wildlife fatalities.

Mining waste volumes are increasing due to higher rates of global metal consumption to meet the needs of the energy transition and a move to mine lower-grade ores (Baker et al. 2020). For low-grade ores, this is because not much material is removed during processing even with very high recovery efficiency, and most of the original ore stays as waste (MMSD 2002). The operation of traditional tailings facilities has accordingly become more challenging. Studies show that the largest facilities can have embankments capable of containing over 1 billion m^3

Figure 2.1 Projected annual average demand on minerals up to 2050 under the IEA energy technology perspective scenarios



Source: World Bank 2020 "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition"

In April 2008, approximately 1,600 migratory birds died trapped in a layer of bitumen in a tailings pond located along the birds' flyway in Alberta, Canada. Investigations showed that a bird deterrence mechanism set up by the tar sands company that owned the tailings was ineffective in keeping the birds from landing on the pond.

of tailings. In 2016 alone, more than 8 billion tonnes of tailings were estimated to have been produced from the extraction of metals and minerals, the largest volume (about 46 per cent) coming from copper mining (Baker et al. 2020).

For some metals, for every unit produced, there may be <1 per cent metal and >99 per cent tailings. It is not surprising then, that tailings facilities are getting larger and larger. Tailings dams can be up to 300m in height and several kilometres across.

It is important to note that while tailings are a necessary waste product of mining, failures of mine tailings facilities are generally due to specific and preventable causes. They include bad management decisions, poor engineering practice, lack of due diligence and lack of independent oversight. Unless these issues are addressed, there will be more such failures, with potentially devastating results.

3. Mapping tailings facilities

It is not recorded anywhere exactly how many mine tailings facilities exist in the world. Estimates range from 3,500–33,000, with about 3,250 recorded as 'active' facilities in a 2020 survey, more than half of which were constructed in the previous 12 years (Franks et al. 2020). The bottom line, however, is that the number of tailings facilities worldwide is at least in the thousands and very likely even higher than the above estimates since studies have been based mainly on companies' voluntary responses to surveys.

A new Global Tailings Portal has been set up by GRID-Arendal (a non-profit environmental communications centre) in collaboration with the Investor Mining and Tailings Safety Initiative (co-chaired by the Church of England Pensions Board and the Swedish National Pension Funds' Council on Ethics), with support from the United Nations Environment Programme (UNEP). The Portal aims to map tailings facilities in a publicly accessible database: https://tailing.grida.no/. Governments can request mining companies operating within their country to disclose the relevant information to the Portal for publication. As of May 2022, the Portal contains disclosures on 1,862 facilities from 106 mining companies.

Figure 3.1 Map view of global tailings storage facilities from the Global Tailings Portal.

4. Why is management of mine tailings relevant to governments?

Major mine tailings incidents have been reported in several Commonwealth member countries, including Australia, Canada, Ghana, Guyana, India, New Zealand, South Africa, the United Kingdom and Zambia. Each of these incidents resulted in either loss of human and animal life or serious damage to the environment or both (WISE Uranium Project 2022). They have generated a sense of urgency among stakeholders to better understand the types of risks posed by mine tailings facilities and the actions that need to be taken to minimise them. Unless there is strong enforcement action on the part of governments to ensure that the costs of tailings clean-up are dealt with internally by companies, potential taxpayer liability for the clean-up might be huge. In 2017, it was estimated that such a potential liability in Alberta, Canada exceeded the approximately USD25.8 billion (CAD41.3 billion) that the province collected in royalties from the oil sands industry from 1970 to 2016 (NRDC and EDF 2017).

All Commonwealth member States have signed up to the **Charter of the Commonwealth**, which includes commitments to transparent and accountable good governance, human rights and protection of the environment, all of which are highly pertinent to mine tailings management.

The governance of mine waste also triggers States' legal obligations to their citizens, including the human rights to a **safe, clean, healthy and sustainable environment** and to **public participation in decision-making**.

Regional or sectoral instruments that are relevant to mine tailings management (in different ways) include:

'Tailings dams are complex...also unforgiving. Their reliability is contingent on consistently flawless execution in planning, in subsurface investigation, in analysis and design, in construction quality, in operational diligence, in monitoring, in regulatory actions, and in risk management at every level. All of those activities are subject to human error.'

Source: Roche et al. 2017

- the **African Charter on Human and Peoples' Rights**, which guarantees a right to a general satisfactory environment;
- the **African Convention on the Conservation of Nature and Natural Resources** (revised 2003);
- the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, better known as **the Escazú Agreement**;
- the United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, better known as **the Aarhus Convention** (to which Cyprus, Malta and the United Kingdom are signatories)**;**
- the **Africa Mining Vision**; and
- the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development **Mining Policy Framework**.

Table 4.1 Sustainable Development Goals (SDGs)

SDG	Areas covered
SDG 9 - Industry, innovation and infrastructure	Reliable, sustainable and resilient infrastructure to support economic development and human well-being
SDG 12 - Responsible consumption and production	Management of wastes minimising adverse impacts on human health and the environment
SDG 15 - Life on land	Protect terrestrial ecosystems, halt land degradation and halt biodiversity loss
SDG 16 – Peace, justice and strong institutions	Accountable institutions, public access to information and participatory decision making

The issue also aligns with and helps to implement other international commitments, including the **UN Guiding Principles on Business and Human Rights**, Resolutions 4/19 and 5/18 adopted by the **United Nations Environment Assembly on Mineral Resource Governance**, and the **2030 Agenda for Sustainable Development** (see Table 4.1). The implementation of the Sustainable Development Goal commitments must be consistent with States' obligations under international human rights law.

5. Impact on communities

Communities local to a tailing facility site have special importance in relation to its planning and operation. They are the population potentially at risk in the event of safety incidents. They are also likely to be the most affected by any adverse environmental impacts caused by the facility. Leaks from tailings ponds may harm the health and livelihood of communities that rely on affected rivers. There may also be cultural or traditional land use issues, or indigenous rights to free, prior and informed consent, before any tailings facility can be permitted. This emphasises the importance for facility operators to share timely, relevant, sufficient and understandable information with local communities and provide avenues for feedback, complaints and ongoing dialogue.

'Estimates suggest that, without action, the frequency of tailings incidents will increase, with tailings dams 100 times more likely to fail than water dams.'

Source: International Commission on Large Dams

A coalition of more than 100 non-governmental organisations globally, led by Earthworks and MiningWatch Canada, launched a report in 2020 called *Safety First: Guidelines for Responsible Mine Tailings Management*, which calls for 16 specific areas of improvement for tailings management (Morrill et al. 2022). These include the process of meaningfully engaging with potentially affected communities and obtaining their consent for any tailings facilities. The report emphasises the need for ongoing dialogue with communities during the entire life of a mine for both existing and planned facilities. It also emphasises the need for an independent grievance mechanism for resolving disputes between companies and communities and other affected persons.

Co-convenors of the Global Industry Standard for Tailings Management

United Nations Environment Programme (UNEP), the agency responsible for coordinating responses to environmental issues within the United Nations system: **www.unep.org/explore-topics/extractives**

International Council on Mining and Metals (ICMM), led by the CEOs of 28 of the world's largest mining companies and representing approximately 30 per cent of the global metals market: **www.icmm.com/**

Principles for Responsible Investment (PRI), representing investors in mining projects, with over 4,000 members managing $ trillions of funding: **www.unpri.org/**

6. What is the Global Industry Standard on Tailings Management 2020?

The Global Industry Standard on Tailings Management (**GISTM**), launched in August 2020, is the first document to set out international specified standards for industry to meet in managing mine tailings, integrating social, environmental, economic and technical aspects across a facility's entire lifecycle. The GISTM was produced by three co-convenors (see text box) and a multi-disciplinary **Expert Panel** with input from a multi-stakeholder **Advisory Group** and public consultations. It aims to strengthen current tailings management practices with the ultimate goal of '**zero harm**'. It takes an outcome-based and proportionate approach. This allows for flexibility and innovation from operators while requiring more urgent actions for higher-risk facilities (based on a 'consequence classification' risk-rating).

The GISTM is available in eight different languages at: **https://globaltailingsreview.org/global-industry-standard/.**

7. What does the The Global Industry Standard on Tailings Management cover?

The Global Industry Standard on Tailings Management is organised around six Topic areas (see Table 7.1), 15 Principles and 77 auditable Requirements. It also contains annexes with a

Table 7.1 Global Industry Standard on Tailings Management (GISTM)

Topic	Explanation
Affected communities	
Respect human rights by conducting due diligence to identify and address those rights most at risk. Provide opportunities for meaningful engagement of project-affected people in decisions that may have a bearing on public safety and the integrity of the tailings facility.	The GISTM signals a significant shift in approach by placing local people front and centre of facility design and management. Referencing international human rights norms such as the UN Guiding Principles on Business and Human Rights and the specific right of indigenous peoples to free, prior and informed consent, the GISTM requires meaningful engagement of local communities, as well as accessible grievance mechanisms and remedies for any affected persons.
Integrated knowledge base	
Develop and document knowledge about the social, environmental and local economic context of a proposed or existing tailings facility. This multi-disciplinary knowledge base will support informed decision-making by operators and key stakeholders throughout the tailings facility lifecycle, e.g., in alternatives analyses, impact assessments, choice of technologies, consequence classification, emergency response plans and closure planning	The GISTM stresses the importance of understanding and documenting all aspects of the relevant local context and of the site facility, including detailed breach analysis and planning in the event of dam failure. It requires attention to social, economic and environmental knowledge collection and maintenance.
Design, construction, operation and monitoring	
Develop a robust design and establish reliable systems for construction, operation and monitoring of tailings facilities, supported by an informed knowledge base to minimise the risk of failure. As social, environmental and local economic contexts are dynamic, demonstrate the ability to upgrade the facility to a higher consequence classification or, where this is not feasible, reduce the consequences of a potential failure.	The GISTM requires tailings facility designs, including plans for closure, to be developed and reviewed in detail prior to mine approval. Routine monitoring and independent review are required within an 'adaptive management' approach and best operational practice throughout the facility's life cycle (recognising that practice over time can differ from initial plans). Classification of dams should factor in the consequence of failure (not only probability).
Management and governance	
Assign responsibility and accountability for key roles in the management of a tailings facility. Establish standards for critical systems and processes essential to upholding the integrity of a facility throughout its lifecycle. Support cross-functional collaboration and promote an organisational culture that welcomes the identification of problems and protects whistle-blowers.	The onus for the performance and cost of a tailings facility rests with the company and its personnel. The GISTM sets specific requirements and accountabilities for key management and engineering positions and promotes the development of an effective corporate and risk management system and culture from the top. This includes performance incentives for safety, whistle-blowing and reporting mechanisms and adequate financial allocation.
Emergency response and long-term recovery	
Establish a community-focused emergency preparedness and response plan. Consider the adequacy of capacity both internally and externally to respond to and engage with communities, the public sector and other agencies to prepare for a failure. Support the long-term recovery of communities and the environment affected by a catastrophic tailings facility failure.	Emergency preparedness and response planning should be multi-stakeholder and community-focused, should take into account scenario planning for consequences of failure, should prioritise the participation of potentially affected communities and should provide for immediate humanitarian assistance in the event of catastrophic facility failure.
Public disclosure and access to information	
Disclose relevant information about the tailings facility to support public accountability. Commit to participation in global initiatives for the creation of standardised, independent, industry-wide and publicly accessible information about the safety and integrity of tailings facilities.	The GISTM requires the proactive publication and regular updating of relevant information, including annual performance and safety reviews. Operators must have a system for receiving and responding to stakeholder requests and should cooperate with global transparency initiatives, including the Global Tailings Portal.

glossary, consequence classification tables and summary tables (of key roles, functions, documents and levels of review mentioned in the GISTM).

Consultation on the draft *Global Industry Standard on Tailings Management*

Public consultation on the draft GISTM was run in 2019 in 17 languages via an online portal, an email response facility and 21 in-country workshops, including in Australia, Ghana and South Africa in the Commonwealth. Overall, 629 consultation responses were received from 32 different countries.

'Given the potentially significant or even catastrophic environmental and social impacts that poorly managed mine waste can have on operations, communities, and ecosystems, governments play a central role in ensuring that these by-products of the mining sector are effectively and safely managed.'

Source: Hill and Gillman 2021

8. Why is the GISTM relevant for governments?

Although the GISTM is directed at 'operators' (the entities that exercise control over a tailings storage facility, which may be in the private sector), its aim and implementation is highly relevant to the state and its duties to its citizens.

If the GISTM succeeds in improving management systems and controls in the local mining industry, this will ease the burden on state regulators, while reducing the risk of future catastrophic failures and ensuring better outcomes for affected people and the environment.

Conformity with the GISTM by operators does not displace the requirements of any specific national, state or local regulations. The GISTM does not impose any obligations on States, but it provides a useful tool that governments can use to identify and secure best-practice standards from tailings facilities operating within their jurisdiction, and implementation of the GISTM can assist governments to work towards existing international law and policy commitments.

Review of national laws may be undertaken against the GISTM to identify existing gaps or possible improvements in the local regulatory framework. Governments may institute interim policies requiring companies to use the GISTM while national standards are developed. They may also wish to require adherence to GISTM by mining companies operating within the country as a requirement of national law or as a precondition to access project permits or financing.

Conformity with GISTM can also be incentivised by governments requiring disclosures of audit and performance reports for tailings facilities and requiring specific reporting against the GISTM in mining companies' annual reports. Publication of such reports would enable stakeholder engagement and public scrutiny.

It may be useful to know that monitoring and auditing of compliance with GISTM can be conducted by independent third parties (whose costs are covered by the tailings facility operators) to avoid a new economic burden being placed on state regulators.

9. How does the GISTM align with other standards/legislation on tailings management?

While the GISTM is an international industry-focused standard, other stakeholders (such as governments) have an important role to play in its implementation.

Different countries have different national guidelines (such as the Australian National Commission on Large Dams (ANCOLD) and the Mining Association of Canada's *Guide to the Management of Tailings Facilities*) along with national legal frameworks and ways of regulating tailings management.

Initial comparative analyses between national legislation and the GISTM have been produced in some key mining jurisdictions, including **Australia,**

Different national laws that may deal with tailings dams:

- Mining
- Mining closure
- Mine safety
- Construction
- Public works
- Dam safety
- Energy
- Natural resources
- Water resources

Brazil, Canada, Chile, China, Ghana, Kazakhstan, Russia and South Africa (Campbell et al. 2020) as well as separately on **Canada and Ghana (Hill and Gillman 2021)**. These generally show a mixture of good practices but also some room for improvement.

As tailings management is not itself about mineral production or income generation, it is an area that can get overlooked. National rules for tailings management may also be split across several different entities, regimes and instruments, which can lead to confusion or gaps.

Some governments may also have had concern in the past that stringent regulation in this area could serve to disincentivise new mining investments.

These are all reasons why the GISTM was produced at a global level. It can serve as a reference resource for national-level rules, reflecting standards that are now acknowledged as essential by a wide range of stakeholders, including industry actors and investors. In 2021, the Mining Association of Canada **updated** its tailings guide to align with the GISTM.

10. Who is already on board with the GISTM?

As well as the United Nations (via **UNEP**) and investors (via **PRI**), there has been strong support for the GISTM from within the mining industry (see box). Mining companies that are members of the International Council on Mining and Metals (ICMM) have already committed that all their tailings facilities with 'Extreme' or 'Very high' potential consequences will conform with the GISTM by August 2023 and all other facilities by August 2025.

Investors were a key stakeholder in developing the GISTM. The Church of England Pensions Board and the Council on Ethics of the Swedish National Pension Funds, on behalf of investors with USD21 trillion in assets under management, have written to over 350 mining companies asking them to confirm their support for the GISTM and to set out a timeline for their intended compliance with it.

Conformity with the GISTM and similar requirements are increasingly also being used as legal covenants in financing agreements, insurance policies and even supply chain purchase agreements, as a new wave of 'investor activism' prioritises environmental, social and governance concerns and the prevention of future humanitarian or environmental disaster.

11. What will be the result if tailings are managed in line with the GISTM or equivalent?

The ultimate aims of the GISTM are to see human lives saved and the environment protected.

There are various reasons why the mining industry may see adoption of the GISTM as a good option:

- When it is a national law requirement or will assist an operator to demonstrate legal compliance.
- When it is a requirement of a financing arrangement.
- When it is a requirement for membership of a professional association (such as ICMM).
- As a means of showing an appropriate standard of care to avoid litigation and liability.
- To reduce corporate risk: tailings management is a high-risk element of a mining project in terms of costs, environmental impacts, health and safety and human rights issues.
- To reduce personal risk: it may assist in accessing insurance or director indemnities in the event of tailings incidents.
- Corporate social responsibility (and enhancement of company value).

In practical terms, if tailings are managed in line with the GISTM or equivalent standards, communities living near tailings facilities would access understandable information about the operation and any risks it may pose and should be able to participate meaningfully in decisions about its management that may affect them.

New tailings storage facilities and management plans would be designed and built so that they prioritise safety over cost, using only the best available techniques, with built-in mitigation measures (e.g., no communities or infrastructure in the line of failure) and with continued monitoring and management by independent experts reporting directly to senior management.

Figure 11.1 Global Industry Standard on Tailings Management (GISTM)

Existing tailings facilities should be reviewed against the same requirements, with the results published and improvements implemented to bring operations in line with the required standards.

12. How can the GISTM be further strengthened?

The GISTM and its implementation are being supported by two other important UNEP-led initiatives: the **Global Tailings Portal** and the **Global Tailings Management Institute (GTMI), which will oversee the implementation of the GISTM**. An international advisory panel drawn from leading figures in tailings management, civil society, industry, finance and academia has been constituted to guide the development of the Institute.

13. What does the GISTM not cover?

While the GISTM is a highly important instrument in striving for 'zero harm' in tailings management, it is not able to cover every aspect.

For example, **abandoned or 'orphaned' facilities** present an issue outside of the GISTM's scope. This is where a mine has closed and there is no longer an operator who can be held accountable for the management of the waste that remains. This may be because the company has ceased to exist or is financially unable or unwilling to carry out necessary steps. Further discussion of this issue can be found in the '**Addressing Legacy Sites**' paper, written to complement the GISTM.

Consequences for non-conformance are not contained within the GISTM; it is a voluntary standard. This is an area where governments may wish to take further steps by adopting GISTM

Figure 12.1 GSTM Implementation Support

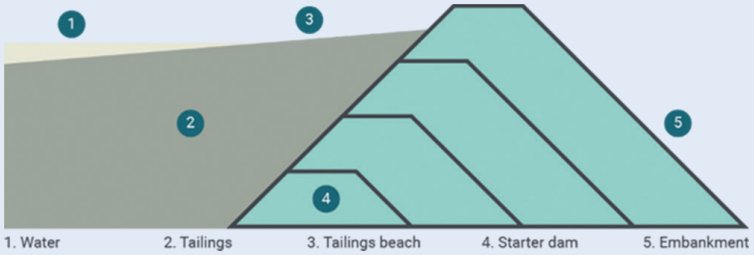
Portal

- This online platform, managed by UNEP-Grid Arendal, currently hosts information about 1,800 tailings dams provided in disclosures from more than 100 companies.

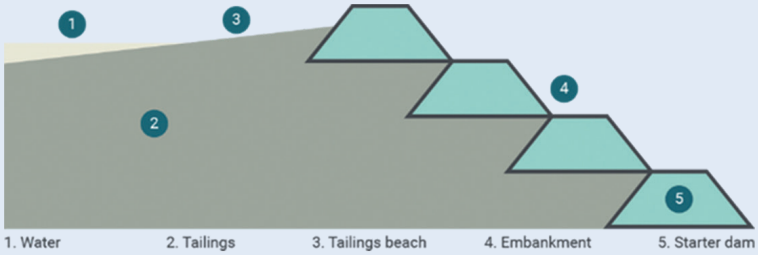
Institute

- The **GTMI** is designed to oversee the implementation of the GISTM, driving safety and accountability in tailings management.
- The GTMI will support auditing of tailing facilities against the GISTM requirements, providing a certification process for independent assessors.
- The GTMI will provide a channel for operator disclosures and facilitate stakeholder access to information.
- The GTMI may also review and revise the GISTM over time.

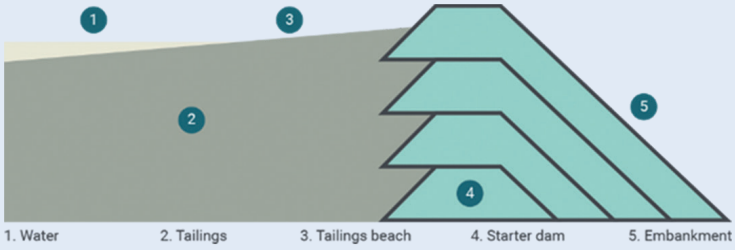
Figure 13.1 Tailings dam construction methods



'Downstream' construction



'Upstream' construction



'Centreline' construction

There are different types of tailings dam construction methods, commonly known as downstream, upstream and centreline.

Upstream tailings dams – cheaper to build because requiring less construction material – are identified as the least stable. This is because new levels of the raises of the dam are built on top of previously deposited tailings; the underlying tailings can collapse, causing the whole structure to topple.

Upstream dams are no longer permitted in some countries, including Brazil, Chile, Ecuador and Peru.

compliance by operators as a requirement within their national legal frameworks. This would mean mandatory monitoring, auditing and publication regarding GISTM conformance and would enable penalties or other sanctions to be imposed by the State in the event of operator non-compliance. Consequences should be proportionate to the severity or level of risk of such non-compliance.

Specific prohibitions can be placed on, for example, certain dam structure designs being used or facilities being built within prescribed distances from communities, which takes into account timings of possible floods and evacuation. Some governments *have* chosen to make such prohibitions in their national laws, and Commonwealth countries may wish to consider these options also.

While the GISTM requires operators 'to confirm that adequate financial capacity is available', this falls short of a requirement for specific **financial assurance** for facility management and closure at the end of the life cycle, based on detailed cost estimates and commensurate with risk levels. Financial assurances (such as a bond or guarantee) work to incentivise compliance and also provide resources that can be used by the government to avoid or remedy any adverse consequences resulting from abandonment of facilities or other failure to meet standards, especially in the case of operator insolvency. This is an area that can be addressed in government regulation.

Liability insurance is another important mechanism to implement the 'polluter pays' principle and to protect the State and potentially affected persons in the event of financial shortfall. Insurers can also play a useful role to demand best-practice standards for the facilities they are insuring. The GISTM requires such insurance 'to the extent commercially reasonable'. States may wish to impose a more specific mandatory duty to cover insurance for catastrophic events.

Besides tailings management, it is essential to **minimise waste volumes** in the future, e.g., via innovation, reusing, reprocessing or repurposing.

14. What can Commonwealth governments do to make the management of tailings safer for communities and the environment?

- Commission or conduct review to identify gaps in the national legal framework.
- Revise or develop relevant regulations in line with the GISTM or similar standards.
- Make adherence to the GISTM by mining companies a requirement in national regulatory frameworks or a condition for grant of a project permit or financing.
- Require and publish disclosures of audits and performance reports for tailings facilities.
- Require reporting against the GISTM in mining companies' annual reports.

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