TAILINGS DAMS | METALS AND MINING

Understanding the Environmental and Social Impact of Tailings Releases

Sustainability is our business

Introduction

This brochure outlines ERM's approach to supporting the mining industry on understanding the potential environmental and social impacts resulting from a dam failure.

The consequence of such failures have historically been poorly understood at a corporate or investment level. Data suggests that dam failures are becoming more prevalent, and the impact of failure has substantial consequence to people and the environment.

There is a need for the potential consequences to be better understood to support on going operational needs and for quick-fire investment decision making.

This brochure, therefore, outlines an approach for rapid screening of operations for investment and due diligence where a potential target has not provided full disclosure of relevant information.

The brochure goes on to outline an approach to generating a more detailed social and environmental knowledge base for a company's assets to support its commitments to be compliant with the requirements of the Global Industry Standard on Tailings Management (GISTM).

All too often there are negative headlines spreading around the world following an incident from which the automatic reaction is to focus attention on one relatively small aspect of an operational environment. Such incidents have occurred when there are reported water shortages, impacts on biodiversity, impacts on cultural heritage or when a range of agitated stakeholders from local communities become concerned about the operation of a particular asset. These incidents drive a short-lived impetus to better understand the potential for something similar to occur at other operations but rarely contribute to the development of a sustainable asset level environmental and social knowledge base.

The GISTM requirement for a knowledge base is putting mining organisations in a much better position through the need to identify the potential impacts from tailings dam failures in a proactive manner where a reactive response would clearly no longer be tolerable to external stakeholders.

This knowledge base approach is required to help organisations to be aware of the consequence, plan appropriately for it and have access to relevant information to provide a baseline data set. This will help to demonstrate that the social and environmental setting is well understood and the needs of the people and the methods for environmental restoration are going to be managed effectively.

Despite many good intentions and investments in improved practices, large storage facilities, built to contain mine tailings can leak or collapse. These incidents are even more probable due to climate change effects. When they occur, they can destroy entire communities and livelihoods and remain the biggest environmental disaster threat related to mining.

Ligia Noronha
Director Economy Division,
United Nations Environment Programme

This is an important stage in corporate compliance with the Global Industry Standard on Tailings Management and I welcome the transparency as to the progress that has been made by ICMM Members and the areas where further work is still needed. I have seen firsthand the extensive efforts by companies to implement the Standard and some of the challenges.

As a result, I am quite clear that investors would far rather have full implementation done well than rushed as a tick box exercise. We are particularly keen to see evidence of implementation from non-ICMM members and will be engaging those companies on their intended implementation ahead of the planned formation of a Global Tailings Management Institute, which will further support wider industry efforts and sharing of best practice.

Adam Matthews
Chief Responsible Investment Officer, Church of England Pensions Board and PRI representative for the Global Industry Standard on Tailings Management and Global Tailings Management Institute.

Dam Failures

Brazil suffered two of the world's worst mining disasters following the collapse of tailings dams in both 2015 and 2019. These events led to considerable loss of life, damage to the environment, financial cost to the companies and a re-think within the mining industry around what is considered to be an acceptable risk.

The rate of tailings dam failures and the resulting consequence are gradually increasing. A study by Lindsay Newland Bowker illustrates how the event frequency is increasing for both serious and very serious incidents. This is in part likely to be a result of the increase in the size of mining operations, grade of the ore but also plausibly a result of ageing infrastructure and impacts from climate change.

Following the Brazilian tragedies, the mining industry is being pushed by investors and through the development of the GISTM to better assess, monitor and prepare for risks associated with tailings dams. Not only are mining companies being asked to do these things but they are also being asked to disclose publicly on their progress. The first wave of disclosure happened in August this year (2023) with expectations that the gaps identified will be closed promptly and that the next phase of disclosure for lower consequence dams will follow by August 2025.

Dam Failures

It is worth noting that whilst the tragic loss of life and scale of the disasters in Brazil made international headline news, there continues to be routine (often unreported in the media) failures of dams around the world.

Since the Brumadinho disaster in January 2019 there have been a further 21 incidents involving releases – including significant failures - resulting in millions of tonnes of tailings being released into the environment.

Chronology of major tailings dam failures (wise-uranium.org)

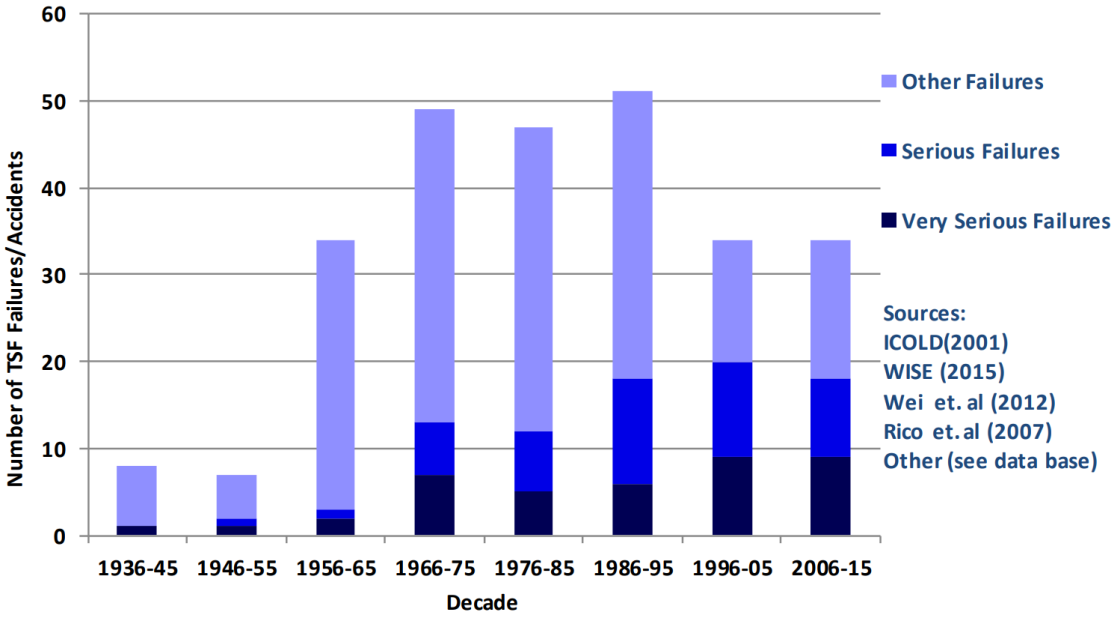
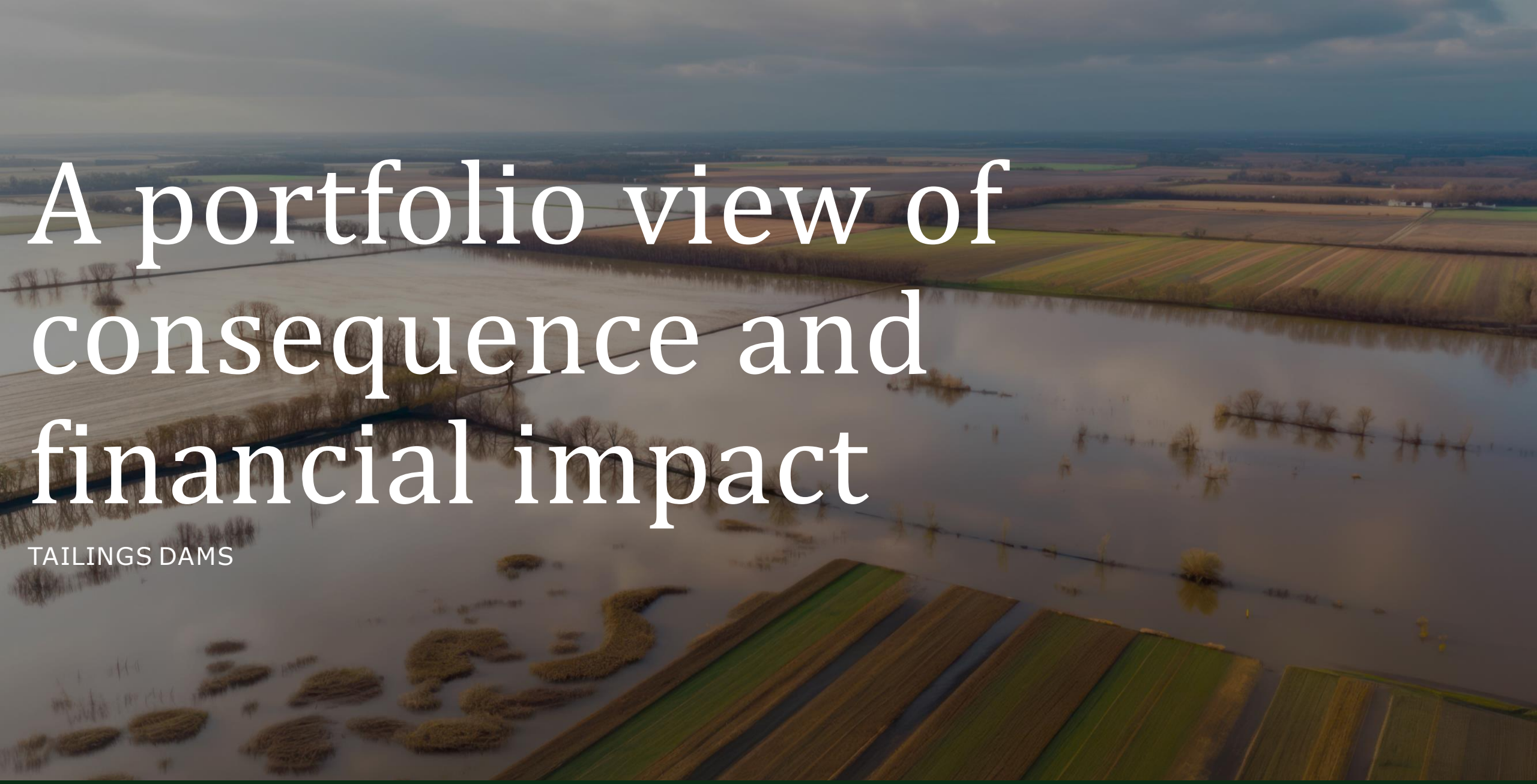


Figure 2. Increasing Severity of TSF Failures Globally by Decade 1936-2015

From: Root Causes of Tailings Dam Overtopping: The Economics of Risk & Consequence, Bowker and Chambers, July 2015



A portfolio view of consequence and financial impact

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Screening Level

In an effort to help mining organizations make appropriate decisions relating to the potential consequence from dam failures ERM has developed a screening tool which plots the relative potential of a release based on tailings dam factors against the consequence of a loss. The approach works for legacy, operational, future dams and plays an important role in decision making for due diligence purposes.

This approach has been developed as it is problematic to measure or monitor key indicators of a dams current condition and potential for failure when trying to rapidly analyse dam risks across a portfolio.

The tool makes use of reported data on construction factors, age, material, volume, physical setting, etc., to provide a company with a relative view on hazard factors which could contribute to a failure.

A high-level social and environmental assessment is then undertaken. This involves the creation of a hypothetical flow path from a tailings dam which is then buffered to provide a theoretical impact. The receptors in the potential line of fire from a release are then identified within a critical distance based on estimated impact timings where people may not have sufficient time to respond and get to safety. This impact area can be reduced or extended as required for a project and can include formally prepared breach assessments where these exist.

The results for the operational and consequential aspects are the categorized and ranked:

RISK LEVEL	Consequential Risk Category Definitions			Consequential Risk Score
	Surface Water	Property (within 20km)	Land Use	
VERY LOW	No surface water course	No properties	No sensitive land use	1
LOW	>1km to River. No Reservoirs within 50km	< 10 properties	Low level land classification dominant in 20km zone	2
MODERATE	<1km to River, No Reservoirs within 50km	10-100 Properties	Some mid Level (IUCN Categories I- IV) within 20km zone	3
HIGH	<500m to River and Reservoirs within 50km or <100km to the coast	100-1000 Properties	Extensive high category Protected Areas within 20km Zone	4
VERY HIGH	TBD	>1,000 Properties	TBD	7

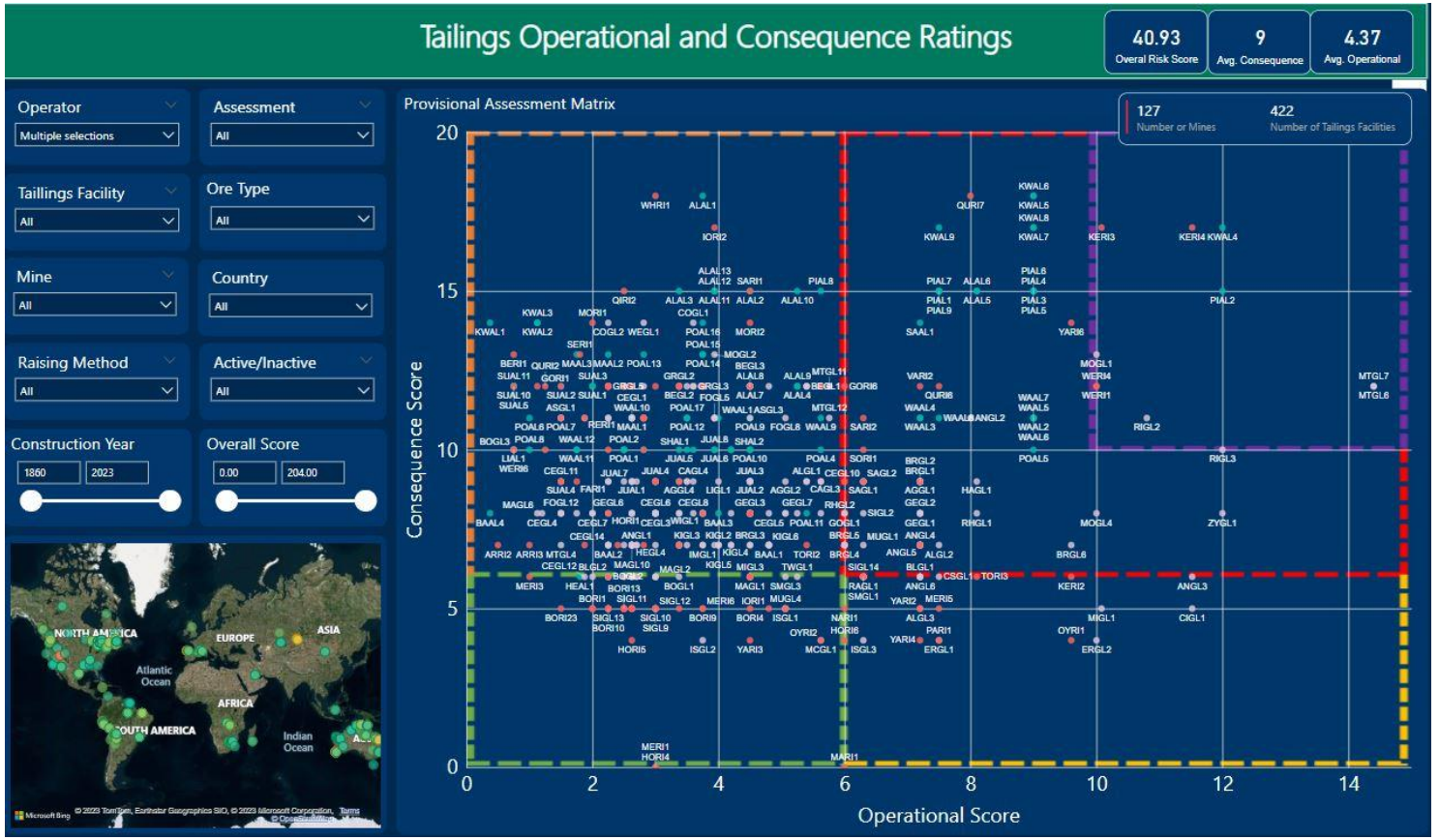
Using the output

The proximity of properties, protected areas, ground cover type, surface water bodies and more are evaluated in a GIS system. Results of the simulations can be visualized and the GIS system used to highlight high consequence areas both in terms of the detail of the affected receptor but also through estimation of cost.

The information on the operational factors and consequence are then plotted on a graph to help identify the most sensitive of tailings facilities.

The approach is intended to provide a rapid assessment of a companies assets and to help enable prioritisation for further analysis (whether owned or as a target for acquisition). The whole process takes hours to prepare rather than days or weeks which may be required to build a detailed site level knowledge base on the social and environmental setting of an operation (see subsequent sections for how this can be developed for GISTM compliance).

The output is usable by non-specialists and provides both a high level overview of the portfolio alongside specific information on risk drivers which can help focus discussions to rapidly obtain more information which will provide the greatest value in the decision making process.



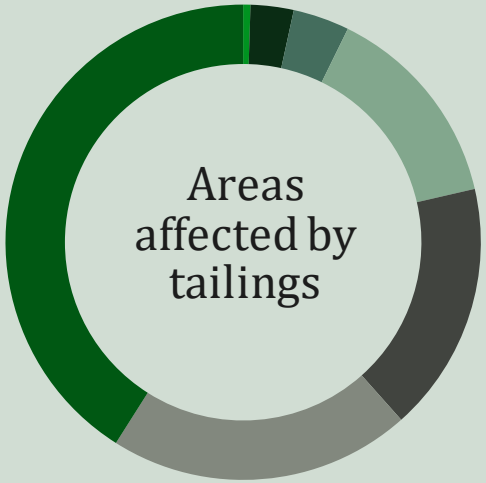
Estimating the financial impact and response planning

In conjunction with information on potential consequences from a release including the analysis of receptor impacts, ERM has developed a GIS-based tool which can be used to generate an overview of the human and natural capital which lies downstream from a company's tailings facilities. When overlaid with predictive spill modelling it can be used to estimate the potential loss of life and environmental damage which could result from a disaster.

These data in turn can be used to estimate the potential financial exposure of an operator to an incident. Aspects relating to fines and the longer-term impact on the economy due to lost tourism, agricultural impacts, etc can also be factored in.

The information can be used to equip an operation with the right information to develop detailed response plans. These response plans consider the specifics of the impact, enabling operations to consider how they will source water for affected communities or consider how biodiversity can be re-established and how to compensate people for loss of property or livestock, etc. In essence it provides the information required to determine how to respond to an incident.

The graphic illustrates the extent and range of impacts caused by the Fundão tailings dam release:



Tree Vegetation (natural and silviculture) *830 hectares*

Buildings *816 (10 hectares)*

Tailings Dam *59.2 hectares*

Bare Soil *77.6 hectares*

Hydroelectric Installations *286 hectares*

Watercourses *344 hectares*

Grassland *416 hectares*

External Factors

- Fines/Penalties
- Compensation
- Infrastructure Loss
- Reputational Damage
- Share price effect

Building a knowledge base

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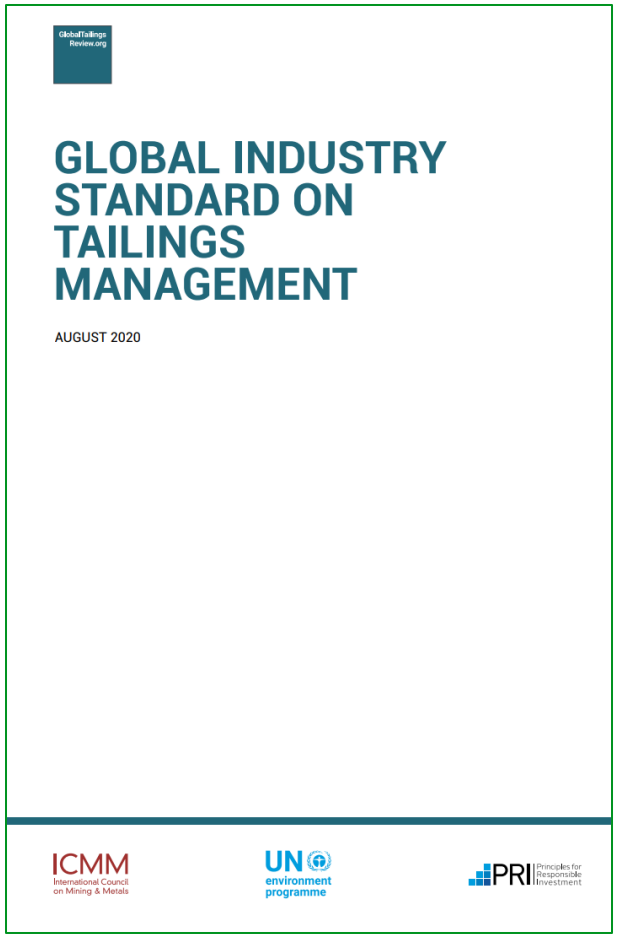
What is GISTM

GISTM is the Global Industry Standard on Tailings Management and was created following investor concerns over the mining industries performance on dam safety following the tragic incidents in Brazil.

The various conformance protocols within the GISTM were developed by ERM in partnership with Klohn Crippen Berger Ltd (KCB) on behalf of ICMM.

The GISTM comprises a set of protocols which mining organisations have committed to adhering to. This adherence also includes a commitment to disclose details about their compliance, identify gaps and to work to close those gaps promptly. The process is staged so that the tailings dams with the greatest consequence to people and the environment are assessed first with the remainder to be completed by August 2025. As a provider of independent assurance in the mining sector, ERM CVS (part of the ERM Group) can provide third-party validation of your GISTM disclosures.



THE STANDARD COVERS SIX KEY TOPICS:

1. **affected communities**;
2. **integrated knowledge base**;
3. design, construction, operation and monitoring of tailings facilities;
4. management and governance;
5. emergency response and long-term recovery; and
6. public disclosure and access to information.

global-industry-standard_EN.pdf (globaltailingsreview.org)

tailings_conformance-protocols.pdf (icmm.com)

GISTM knowledge base

The GISTM environmental and social knowledge base is an explicit requirement (TOPIC II) within the GISTM standard. The standard itself is supported by implementation protocols which provide detailed guidance for certification or assurance as applicable.

Once developed, the knowledge base plays an important role in contributing to all of the other GISTM topics covered within the standard. It is required, for example to help manage information relating to the locations of potentially affected people, it contributes to preparing an appropriate emergency response and recovery plan and providing (at some point in time) public disclosure of relevant information.

Important in this whole process is an operators ability to demonstrate the social and environmental condition at the time of an incident. Its data becomes critical in supporting appropriate recovery efforts and in ensuring that the right improvements are put in place to reduce the potential for harm to occur. Forearmed with such knowledge some poor decisions which were exposed through prior events would have been avoidable.

There is an expectation that the knowledge base will include the following key components:

- Document knowledge about the social, environmental and local economic context of the tailings facility including uncertainty related to climate change.
- Prepare, document and update a detailed site characterisation of the tailings facility site(s) that includes data on climate, geomorphology, geology, geochemistry, hydrology and hydrogeology (surface and groundwater flow and quality), geotechnical, and seismicity.
- Develop and document a breach analysis for the tailings facility using a methodology that considers credible failure modes, site conditions, and the properties of the slurry.
- In order to identify the groups most at risk, refer to the updated tailings facility breach analysis to assess and document potential human exposure and vulnerability to tailings facility credible failure scenarios.

Social and environmental damage from tailings disasters can be catastrophic as shown in the aftermath of the Samarco dam failure

Creating a data asset

A knowledge base can be developed in different ways – from a simple catalogue of reports on a SharePoint site through to a fully accessible data driven system which utilises web-GIS and dashboard platforms to enable rapid retrieval and analysis of pertinent information.

The approach outlined here demonstrates value through adopting a highly digitally transformative and geospatially driven knowledge base.

The geospatial based approach can be used for facilities worldwide and identification of downstream areas can help produce information for a wide range of purposes. Data within the system can easily be updated and expanded to capture new work and its accessibility to an entire organisation can enable further value to be derived from the creation of this data asset.

Our approach to knowledge base development includes curation of public data for the operations alongside extraction of relevant site level data to form a comprehensive view of the social and environmental setting of the asset. The output provides a fully searchable location-enabled knowledge base for each site, operating group or the portfolio as a whole can quickly access data extracts, supporting reports and a fully operational GIS that presents location and attribute information on the social, economic and environmental settings.

Equally important is the identification of key gaps in knowledge which are prioritised and from which programmes of remote data collection or site level work can be prepared to fill those gaps. The approach measures data availability against more than 100 different social, economic and environmental themes covering topics which include physical risks, protected areas, climate and climate change information, biodiversity, water environment, community, social, infrastructure, and more. The data can be used to set internal targets and goals for completion of the knowledge base and the content can be widely shared to provide that knowledge for multiple purposes.

About ERM

Sustainability is our business

As the largest global pure play sustainability consultancy, ERM partners with the world's leading organizations, creating innovative solutions to sustainability challenges and unlocking commercial opportunities that meet the needs of today while preserving opportunity for future generations.

ERM's diverse team of 8,000+ world-class experts in over 150 offices in more than 40 countries supports clients across the breadth of their organizations to operationalize sustainability. Through ERM's deep technical expertise, clients are well positioned to address their environmental, health, safety, risk, and social issues. ERM calls this capability its "boots to boardroom" approach - a comprehensive service model that allows ERM to develop strategic and technical solutions that advance objectives on the ground or at the executive level.

Thank you

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