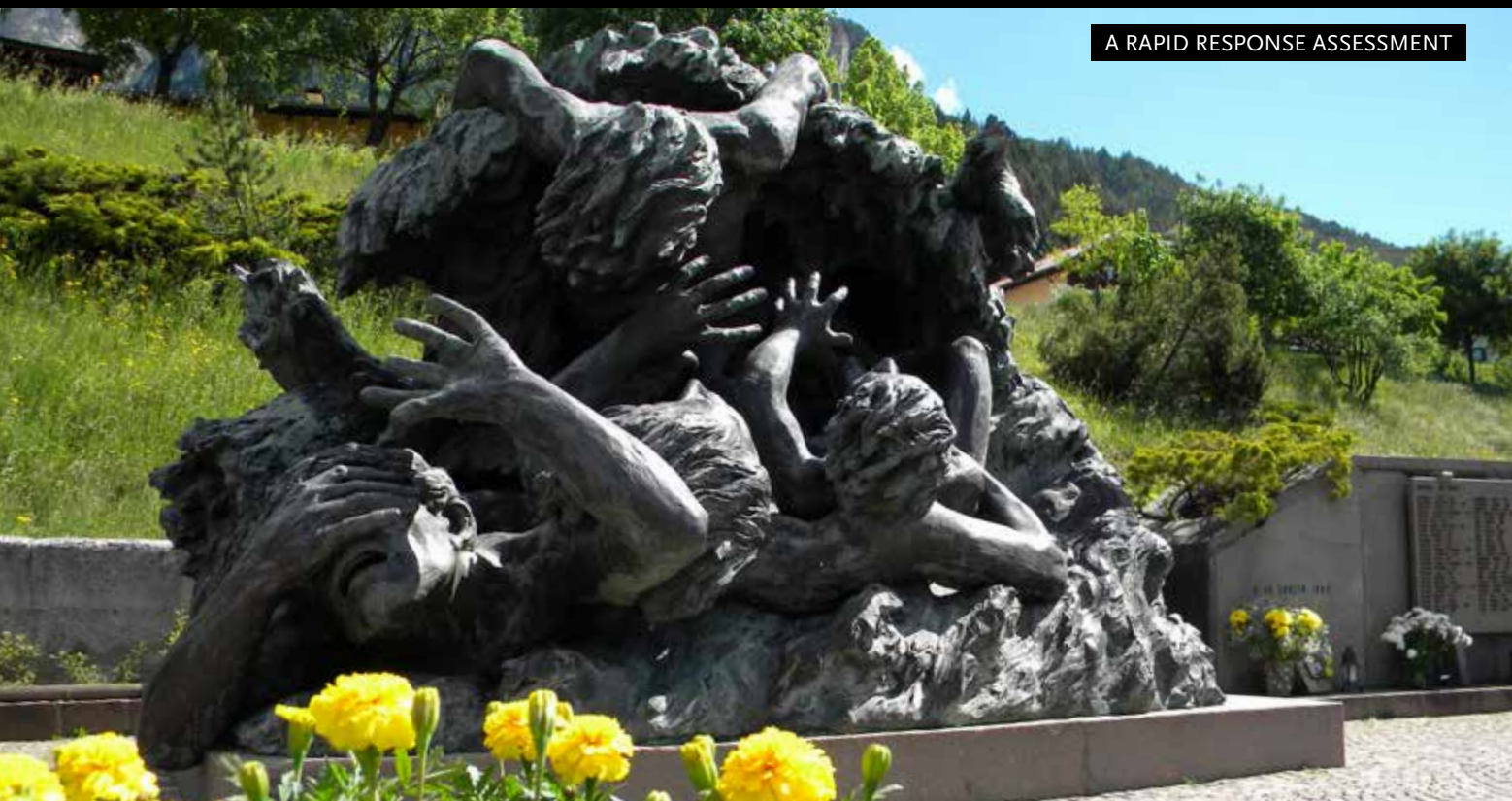
UN environment | GRID ARENDAL

REPORT SUMMARY

MINE TAILINGS STORAGE: SAFETY IS NO ACCIDENT

A RAPID RESPONSE ASSESSMENT



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.

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).

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.

Crisis response

- **Establish** a global financial assurance system for mine-sites.
- **Fund** a global insurance pool.

Benefits

- **Ensures** best practice in tailings management, monitoring and rehabilitation
- **Addresses** unmet liabilities from major tailings dam failures.

Note: Some of these important actions are already being undertaken or partially implemented in a number of jurisdictions. The aim is to ensure best practice is enacted at all mine sites where tailings are stored.

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Developing the green technologies needed to achieve the 2030 Sustainable Development Goals means the demand for large quantities of minerals and metals will continue to grow for the foreseeable future. Safer, cleaner and less wasteful extraction and production is paramount to ensuring resource availability, but also community well-being and ecosystem resilience.

Mining companies, communities and governments recognize that mine waste, contaminated water and land pollution damage lives and livelihoods but also threaten the development of the mining sector. For this reason, they are committed to work together to reduce the industry's footprint.

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.

The mining industry has acknowledged that preventing catastrophic tailings dam incidents with zero fatalities and environmental protection is fundamental and achievable. For decades, companies, industry bodies and regulators have been continually improving best practice guidelines for the construction and management of tailings dams. However, eliminating all catastrophic incidents remains a challenge.

The United Nations Environment Rapid Response Assessment on mine tailings looks at why existing engineering and technical knowhow to build and maintain safe tailings storage facilities is insufficient to meet the target of zero catastrophic incidents. It examines the ways in which the established best practice solutions in international collaborative governance, enhanced regulations, more resource efficient approaches and innovation could help to ensure the elimination of tailings dam failures. It uses case studies from different parts of the world to highlight the efforts of industry to reduce mine waste and stimulate new activities while suggesting how these could be accelerated through regulatory or financial incentives.

It is hoped that this report will encourage targeted action at the policy and technical level to make zero catastrophic incidents become a reality and ensure that economic prosperity is fully compatible with community health and safety.

Ligia Noronha
Director Economy Division
United Nations Environment Programme

The Rapid Response Assessment makes two recommendations and suggests a range of policy actions aimed at catalysing the change needed to ensure tailings dam safety. These actions stem from the first recommendation – the mining industry's acknowledged priority of "safety first".

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.

Known mining accidents the last decade

- **Very serious tailings dam failures**
  Multiple loss of life (~20) and/or release of ≥ 1 000 000 m^3 total discharge, and/or travel of 20 km or more.
- **Serious tailings dam failures**
  Loss of life and/or release of ≥ 100 000 m^3 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.

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

An analysis of tailings dam failures indicates that while the overall number of failures has decreased, the number of serious failures has increased in the last three decades.

Collective action to improve tailings safety

Mining Tailings Storage: Safety is no accident, was prompted by tailings dams disasters and rising global concerns about the safety, management and impacts of storing and managing large volumes of mine tailings.

The increasing number and size of tailings dams around the globe magnifies the potential environmental, social and economic cost of catastrophic failure impact and the risks and costs of perpetual management. These risks present a challenge for this generation, and if not addressed now, a debt we will leave to future generations.

As a rapid response assessment, the report informs a wider audience of the consequences of failure, the disproportionate impact on indigenous and poor communities and importantly, the opportunities to reduce risk and improve safety. Adopting cleaner processes, new technologies, reusing materials, and better regulations and management will all contribute to a safer mining environment.

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 has seen reduction in catastrophic failures. We need to build on these successes.

The challenge now is for collective action. To embrace the technological and management reforms that can both reduce risk and the environmental footprint of mining. 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.

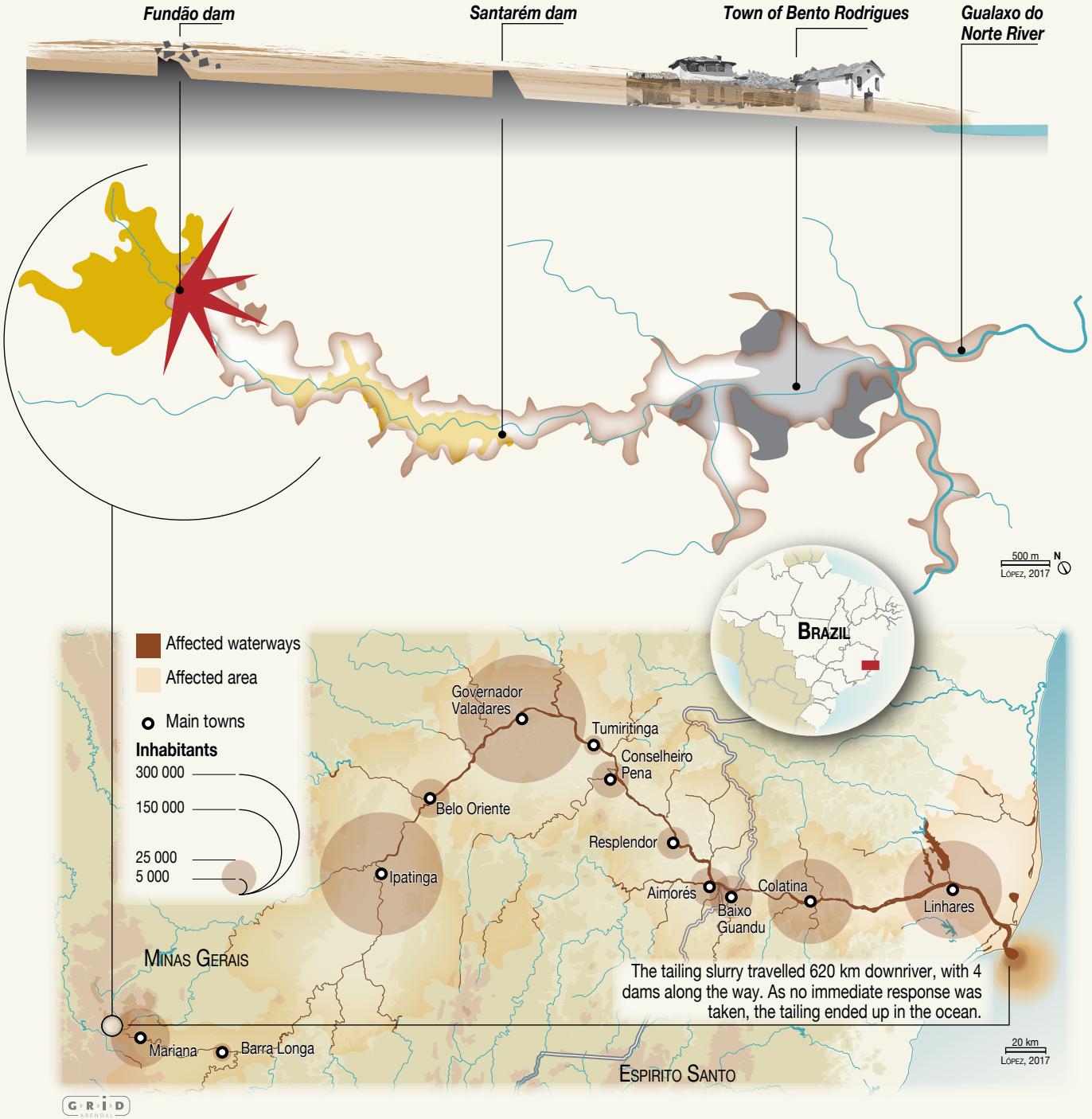
Chris Blake

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 m^3 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.

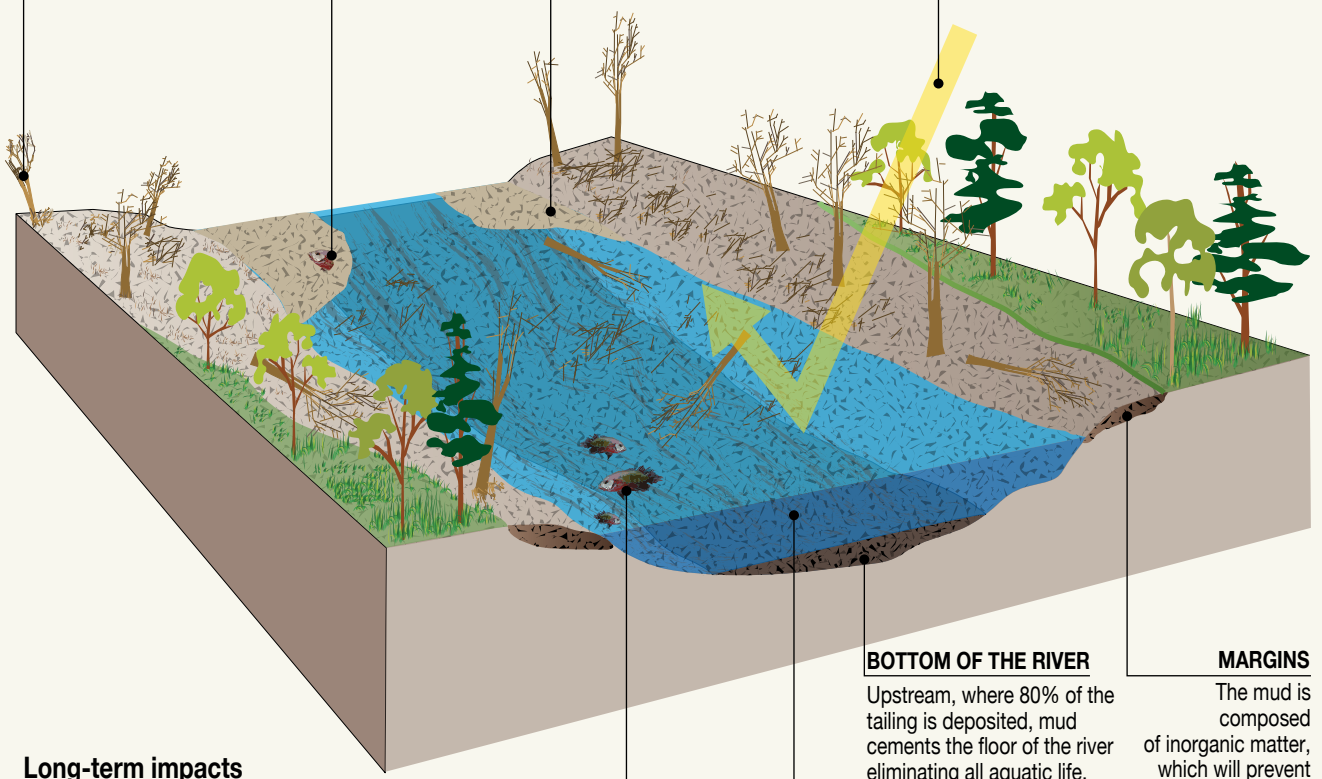
HERITAGE
Numerous colonial monuments dating back to the 1700s were destroyed.

INFRASTRUCTURE
The slurry filled 663 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.



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.

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.

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; Alex Bastos Universidade Federal do Espírito Santo, Brazil.*

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Prof. Valeria Quaresma

"Tailings dams are complex systems that have evolved over the years. They are also unforgiving systems, in terms of the number of things that have to go right. 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 these activities are subject to human error."

(Mount Polley Expert Panel, IEEIRP 2015, p. 119)

Some key facts

- Despite the many advances made in the mining sector and increased geotechnical engineering knowledge, tailings dam failures still occur. Since 2014 there have been eight failures significant enough to make global news. These occurred in Canada, Mexico, Brazil (twice), China, USA and Israel.
- Large tailings dam failures can release a tsunami-like wave of mine waste capable of destroying everything in its path.
- Leaking and collapsing tailings dams can result in long term environmental damage.
- Although for many years the overall number of annual tailings dam failures has declined, the number of serious failures has increased.
- There is no publicly accessible inventory of tailings dams, however, one estimate has put the number of tailings dams at 3,500. This is likely an underestimate since there could be more than 30,000 industrial mines.
- The global volume of stored tailings is also unknown but recent disasters illustrate the potential scale of accidents. For example, the Mount Polley and Samarco failures in 2014 and 2015 each respectively released more than 25 million cubic metres of tailings into the environment. Combined, this represents enough material to fill more than 20,000 Olympic swimming pools.
- The cost of tailings dam failures to industry can be in the many millions of dollars.