

# **The Mirador Mine in Ecuador**

<https://www.bnamericas.com/company-profile/en/ecuacorriente-sa-ecuacorriente>

## **Another disaster waiting to happen.?**

**YES**

In order to bring the situation affecting the Mirador Mine into perspective I am including information on the recent Tailings Dam failure in Brazil.

On Friday, January 25<sup>th</sup>. 2019, the 42 year old Brumadinho Tailings Dam in Brazil collapsed. On January 30<sup>th</sup>. news outlets declared that 99 people had been found dead, and the chances of finding a further 259 people missing were declared slim. Vale, one of the world's biggest mining companies, has had \$3bn frozen from its accounts to pay damages, fines, penalties and the funding of recovery work. Five arrests have been made.

<https://www.bbc.com/news/business-47054328>

The environmental damage will not only affect this generation. The killing of Nature by poisoning is like killing ourselves. Can we put a price on that.?



<https://www.bbc.com/news/world-latin-america-47021084>

The ongoing list of damages and deaths attributed to this collapse puts the Mirador Mine situation into sharp focus, and once again obligates us to ask the question. **Can we afford to take these risks with our environment.?**

### **The Mirador Mine**

Facilities were given a **Very High risk** category in the 2007 consulting report by Knight-Piesold using criteria provided by the Guidelines of the Canadian Dam Association. The same criteria were used in the 2010 Environmental Impact Study, and again in 2011 in response to questions

from the Ministry of the Environment.. **Risk** refers to the consequences of dam failure.

The mine should be designed to withstand the Maximum Credible Earthquake.

I think it is important to clarify the definitions used in tailings dam design.

**MDE** = Maximum design earthquake. This is the earthquake for which a dam has been designed

**MCE** = Maximum credible earthquake that is theoretically possible at a particular location

**OBE** = Operating Base Earthquake is an earthquake that is expected to happen during the life of the project.

**.PMF** = Probable maximum flood

The risk category derived from the consequence of failure relates to the population at risk, loss of life, the impact on environmental and cultural values, and the impact on infrastructure and economics. A category of “**very high risk**” necessitates a **very high standard** of safety in construction and management.

Cardno Consulting disregarded both the 2007 consulting report and the 2010 Environmental Impact Study. (Cardno EIS 2014)

.Both of the risk factors, the probability of failure and the consequences of failure, had increased, and the consulting firm, in 2014, had disregarded both in favor of cost cutting (Cardno EIS 2014)

**The Mirador Mine in Ecuador** is a mega-mine, under construction in the Cordillera del Condor mountains. These tropical cloud forested mountains are registered by Conservation International as a planetary "hot spot" of bio-diversity. The Cordillera del Condor mountains feed tributaries leading to the River Amazon.

The Chinese company ECSA is building huge structures to hold hundreds of millions of tons of toxic mining waste known as tailings.

Tailings are waste materials, created in this case by the extraction of copper and gold from mined rocks. Tailings are highly toxic and need to be held in impoundments. Impoundments are called tailings storage facilities.

All Tailings facilities are supposed to be built to withstand earthquakes. Facilities are supposed to be built, to avoid internal collapse due to liquefaction of the contents and foundations.

**Excess water.** Collapse can occur owing to excess water causing water overtopping the dam, or piping which occurs when tailings are washed through the dam walls.

**All tailings facilities, all over the world, are supposed to hold toxic waste in perpetuity with no maintenance or inspections.**

Dr. Steven Emerman has supported me in the writing of this article and has rigorously fact checked the content. If you would like to contact Dr. Emerman with any questions, his E mail address is [shemergen@gmail.com](mailto:shemergen@gmail.com)

**Dr. Steven Emerman** is the owner of Malach Consulting, and is the environmental compiler and Vice-Chair of the Board of Directors of the World Mine Tailings Failure Database. His company specializes in groundwater and mining. He is the author of many reports on the Mirador Mine Tailings Facility. He has recently been interviewed by both the BBC and the Wall Street Journal in regards to Tailings Dam safety.

Dr Emerman informs us that the following list comprises the five most common causes leading to the failure of tailings dams. He notes that the distinguishing feature of **the Mirador Mine tailings facilities is that they are susceptible to failure by all of these listed causes.**

**Collapse is inevitable.**

- Earthquake.
- Flooding.
- Internal erosion, also referred to as piping.
- Static liquefaction.
- Foundation failure.

Here are some fundamental **statistics on the failures of tailings dams** sourced from ICOLD, the International Commission on Large Dams.

ICOLD inform us that between 2006 and 2015 there were 18 tailings storage failures. Their prediction, Table 1, for the period 2016 to 2025 is for 30 failures, showing a 67% increase.!

For further and more detailed information you can access the World Mine Tailings Failure Database. <https://worldminetailingsfailures.org/>

It is worth noting that in contrast to water-retention dams, which are dismantled if they cannot be inspected and maintained, tailings dams are simply abandoned after mine closure under the assumption that they will hold back toxic mine tailings in perpetuity with no further maintenance and inspection, therefore, the utmost safety in construction is essential.

Table 1. Anticipated increases in frequency & severity 2016–2025.

Time Period	Very Serious >1 Mm <sup>3</sup>	Serious >100 Km <sup>3</sup>	Cumulative Release Mm <sup>3</sup>	Cumulative Run Out km
2006–2015 (actual)	9	9	895	92
2016–2025 (predicted)	15	15	937	110
Projected % change	+67%	+67%	+5%	+8%

**The Mirador Mine in Ecuador** is being built with two huge waste dumps, (tailings storage facilities). The mine, when in full operation, is expected to produce 60,000 tons of mining waste tailings every day!

In 2011 the Ecuadorian Ministry of the Environment questioned the design and safety of the tailings storage facilities proposed for the mine.

In response to those questions, Ecuacorriente, at that time represented by Walsh Scientists and Engineers, later replaced by Cardno consulting, quoted from the 2007 report by Knight-Piesol.

The report was originally written in English and was later translated into Spanish by Walsh Scientists and Engineers. This part in the original English refers to liquefaction caused by earthquakes.

*“The results indicate that the entire depth of the tailings deposit is potentially liquefiable for the MDE and OBE. Liquefaction is also predicted for the loose alluvial soils near surface (in the upper 10 metres) for the MDE and OBE.”*

Knight-Pièsold, 2007. Rio Quimi Tailings Management Facility Feasibility Study for 27,000 tpd mine production [Estudio de viabilidad de la Instalación de Gestión de Relaves Río Quimi para 27,000 tpd de producción minera]. Ref. No. VA201-78/09-2, 111 p.

The dam could collapse by seismic liquefaction of the tailings without failure (or liquefaction) of the foundations. The report says that both factors are a potential for collapse. The combined, or separate potential realized would release hundreds of millions of tons of toxic waste into the sensitive and vital river systems of the Upper Amazon Basin.

**The vision of the dam walls sliding into their foundations with millions of tons of toxic waste pouring over the collapsed walls is a nightmare that we do not want to experience.**

By 2014, with new alternative plans, the risk factor, both a combination of the probability of failure and the consequences of failure, had increased. and the consulting firm, (Cardno Consulting) had disregarded both in favor of cost cutting.

**The torrent of toxic waste, millions of metric tons, would flow through the steeply inclined river system to reach a main tributary of the upper Amazon rainforest, the Santiago River, and from there**

**it will continue its passage to the Amazon River. This will be a veritable nightmare of pollution.**

In the case of a high rainfall event leading to collapse, the fastest-moving mine tailings would reach the next major confluence where the River Zamora meets the River Santiago, (about 88 km downstream from the Rio Quimi – Rio Zamora confluence), within 5 hours.!

<https://static1.squarespace.com/static/52d71403e4b06286127a1d48/t/564a18c0e4b0f19eae571949/1447696576435/Espanol-Emmerman-Mine-Tailing-Transport11515.pdf>

**The Tundayme dam.** The Chinese are planning to build what will be the tallest tailings dam in the world. This dam, in the valley of the Tundayme River will be 260 meters high, and is proposed to be built with an inclination of 1 meter vertical to 1.5 meters horizontal. (Cardno EIS 2014)

Cardno, 2014. Actualización del Estudio de Impacto y Plan de Manejo Ambiental, para la Fase de Beneficio de Minerales Metálicos (cobre), Ampliación de 30 kt por día a 60 kt por día del Proyecto Minero Mirador, Concesión Minera “Mirador 1 (acumulada)”: Informe a Ecuacorriente S.A., 1206 p. con 6 anexos (1125 p.).

The Tundayme dam was not yet under construction when Dr Emerman visited the site on November 6<sup>th</sup>, 2018.

The dangers of building the tallest tailings dam in the world at a steep angle of slope are clear as stated in a quote I am taking from Dr Emerman:

*. “A slope of 1V:2H is most common for tailings dams. This slope was stated in the EIS and all of the permits for the Mount Polley dam (although it was not followed in practice) and in the EIS for the Mirador dam (although it is not being followed in practice). That is, 1V:2H is generally regarded as providing a sufficient factor of safety for tailings dams.”*

The Environmental Impact Study of 2010 had advised a slope of 1 meter vertical to 2 meters horizontal.

The consequences of the Tundayme collapse will be much greater than that experienced in other tailings dam failures simply because the proposed dam is higher, the highest in the world, meaning that the released tailings will travel a greater distance at a greater speed.

**The facility at Quimi**, There are two facilities at the Mirador mine. This facility will incorporate walls at a height of 63 meters

The 2014 Cardno EIS said that the Quimi dam should be built at a slope of 1 meter vertical to 2 meters horizontal.

Dr Emerman in his visit to the facility on November 6<sup>th</sup> 2018 noted that the slope being built was 1 meter vertical to 1 meter horizontal, a slope angle referred to as a critical angle building on the edge of collapse.

I quote from Dr Emerman

*“An embankment slope of 1V:1H is regarded as a critical maximum slope for the prevention of **pipng (also called internal erosion)**. This information can be found in presentations by consulting companies that design tailings dams and other earthen dams. A high slope (and the resulting high hydraulic gradient) forces water to move rapidly through the dam. This rapid movement washes tailings and other construction material out of the dam, which destroys the structural integrity of the dam. **Failure of earthen dams by pipng has resulted in more deaths than the failures of all civil engineering structures by all causes combined.**”*

The dam is being built at a **critical slope angle**. This is building **on the edge of collapse**.



**Civil engineering structures are not supposed to be built at a critical state at the edge of failure.!**

The U.S. Army Corps of Engineers has stricter safety standards for the dams that they build. They recommend an embankment angle of no steeper than 1 meter vertical to **five meters horizontal** for the prevention of piping.

**The Quimi facility dam** is supposed to hold back an excessively wet mass of tailings **in perpetuity**. The dam is being built in a manner where **piping and collapse are inevitable**.

**The Mirador Mine facilities** are being built in the tropical cloud forests of the Cordillera del Condor with a rainfall of 1.85 metric tons per square meter per year.

The risk category “**Very High**” was confirmed by Walsh on behalf of ECSA, in their 2011 responses to questions from the Ministry of the Environment.

This information was dropped from the Cardno 2014 EIS. Cardno consultants worked on a decision to build for a 500 year flood even though the risk had been increased owing to a doubling of tailings.

Flood standards are not being met in the design of the Mirador Mine tailings facilities.

When these standards are **not met** excess water can cause "overtopping" which will cause catastrophic collapse.

The tailings storage facilities at the Mirador Mine are being built in violation of the Cardno 2014 EIS. The EIS states that the Quimi facility, now under construction, was to be built with a centerline construction with a 1 meter vertical to 2 meters horizontal slope. As I explained earlier, the Quimi facility is being built at a critical slope. **on the edge of collapse**.

**Collapse due to earthquake, flooding, internal erosion, static liquefaction, and foundation failure are all likely.**

In the next part of this article I am drawing your attention to examples of various dam collapses around the world and their resulting devastating environmental consequences.

### **The Mishor Rotem Dam Collapse 2017**



<https://lindsaynewlandbowker.wordpress.com/2017/07/09/tsunami-of-phosphate-tailings-from-icl-plant-inundate-20km-of-dry-valley-near-dead-sea/>

“Israel Chemicals first identified the spill at 11:45 a.m. on Friday (***June 30, 2017***), after workers found a hole in the eastern embankment”. This a clear example of piping.



<https://www.mirror.co.uk/news/uk-news/toxic-tsunami-wastewater-gushes-over-10741676>

You can see in the above picture the incredibly steep slope of the dam wall.

### **The Mount Polley Collapse 2014**



<https://www.youtube.com/watch?v=-ZfCPNy9cPE> Independent panel review of Mount Polley TSF - Full presentation

The above picture is of the **Mount Polley collapse in 2014**. This was caused by foundation collapse. The steep embankment and excess water were contributing factors leading to the most serious environmental disaster in Canadian history.

The mine waste travelled into Quesnel Lake, the deepest freshwater lake in the world, a depth of 1,400 meters. Livelihoods have been lost, fish stocks are decimated and both water and soil remain polluted from the catastrophe.

**The Fundao collapse in 2015** occurred when the contents of the dam turned to liquid. The collapse was triggered by an earthquake measuring a mere 2.6 on the Richter scale. The dam had been suffering structural and drainage problems for several years prior to the collapse.



[https://www.youtube.com/watch?v=KF3Clm6T\\_kI](https://www.youtube.com/watch?v=KF3Clm6T_kI) Investigating BHP's \$5bn Mining Disaster In Brazil

Brazilian President Dilma Rousseff described the event as "the worst environmental disaster Brazil has ever seen".

19 people died and 6,000 people were displaced. 700 kilometers of river remain polluted, drinking water is polluted. The poison reached the Atlantic and fishermen on the coast are affected as well as the towns and villages and Indigenous peoples along the whole length of the river.

**The Mount Polley Dam in British Columbia, the Fundao dam in Brazil, the Mishor Rotem Dam in Israel, and the recent Brumadinho Dam in Brazil, all collapsed for reasons that could have been avoided.**

The Chinese are building their waste dump holding facilities, (tailings storage facilities), in a manner which, if finalized under the present regime of construction, will destroy Ecuador's reputation as a world

leader in environmental protection, and will create a catastrophe, in the Upper Amazon Basin never before seen or imagined.

Both of the tailings storage facilities are being built in contravention of Environmental Impact Studies and pose an unacceptable risk for both the environment and for society.

**A disaster waiting to happen.? Yes, taking into account statistics and the above facts, it is inevitable.**

There is clearly a need for legal action.

David Dene. February 1<sup>st</sup> 2019

Expert in Earth Jurisprudence

UN “Harmony with Nature”.