Report: Likelihood of Spills and Tailings Dam Failure from PolyMet/Glencore's Proposed Copper Sulfide Mine

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Summary

Results from a recent review of the spill records of fourteen copper sulfide mines in the U.S., accounting for 89% of U. S. copper production in 2010, were used to estimate the likelihood of spills and impoundment failures from the proposed PolyMet/Glencore mine. The mines reviewed share many technological designs included in PolyMet/Glencore's NorthMet proposal, and are subject to the same federal environmental regulations. Based on the 1986-2012 record during which the 14 mines had 175 spills and four impoundment failures total, we estimate that the PolyMet/Glencore mine would average five spills per decade (95% confidence interval: 3-8 spills per decade) with a 50% chance of tailings dam failure during the first 54 years. There is less than 0.5% chance that the PolyMet impoundment would perform as designed and not fail for 500 years.

Introduction

The Minnesota Department of Natural Resources (DNR) issued a Permit to Mine for PolyMet/Glencore's proposed NortMet project on November 1, 2018. By granting a permit,

the DNR has indicated their belief that the proposal could be done safely without negative impacts to surrounding surface and groundwater.[1]

However, the USDA Forest Service has pointed out uncertainties that are recognized by PolyMet/Glencore in their Final Environmental Impact Statement:

> *In Minnesota, the Final Environmental Impact Statement for nearby NorthMet Mining Project and Land Exchange recognizes that no matter the depth of analysis and planned containment strategies there remain uncertainties associated with mine development, operation and long-term water and waste rock treatment.*[2]

To evaluate these risks and uncertainties, we reviewed the spill records at 14 out of 16 current copper sulfide mines in the US, accounting for 89% of U.S. copper production from 1986 – 2018. Many of these mines share technological design elements such as open pit waste storage, wet tailings, and upstream dam wall design. The safety of these design elements has been challenged by the United Nations[3], the Independent Expert Review Panel following the Mt. Polley dam failure[4], and some of the DNR's consultants hired to review the PolyMet/Glencore proposal[5].

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[1] Landwehr, Tom, Minnesota Department of Natural Resources Commissioner, personal conversation, August 16, 2017.
[2] Letter from Thomas Tidwell, Chief of Forest Service to Neil Kornze, Director of Bureau of Land Management, U.S. Forest Service. File Code 2670 (Dec. 14, 2016).
[3] United Nations Environmental Program, 2017. *Mine Tailings Storage: Safety Is No Accident, A Rapid Response Assessment.*
[4] IEEIRP (2015) Independent Expert Engineering Investigation and Review Panel. *The Report on the Mount Polley Tailings Storage Facilities Breach.* Vancouver, Province of British Columbia.
[5]Review Team Comments Memorandum from Dick Van Zyl, Steve Gale, Cecilio Olivier, and Stuart Grubb to Jason Boyle, May 15, 2017. Accessed October 2, 2018 at:

The PolyMet/Glencore proposal includes an earthen tailings dam, which is projected to store mining waste for 500 years.[6] Concerns about sulfide mining waste storage are shared by both the United Nations and the Independent Expert Engineering Investigation and Review Panel that investigated the Mount Polley tailings dam failure.

The Independent Expert Engineering Investigation and Review Panel for the Mount Polley dam failure specifically addressed the type of waste storage proposed by PolyMet/Glencore:

> *In risk-based dam safety practice for conventional water dams, some particular level of tolerable risk is often specified that, in turn, implies some tolerable failure rate. The Panel does not accept the concept of a tolerable failure rate for tailings dams. To do so, no matter how small, would institutionalize failure. First Nations will not accept this, the public will not permit it, government will not allow it, and the mining industry will not survive it.*
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> *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*

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https://files.dnr.state.mn.us/lands_minerals/northmet/dam-safety/memo_dam_safety_permit_review20170515

[6] *NorthMet Final Environmental Impact Statement*, November 2015, p. ES-35.

these activities are subject to human error.[7]

The UN, in a report on sulfide mining storage risks worldwide, raised concerns that we have not learned from past mistakes in sulfide mining waste storage:

> *The comprehensive 2001 ICOLD report established an urgent need for the reform of tailings storage-facility planning, management and regulation. The authors found that all 221 failures examined were avoidable – that the technical knowledge to build and maintain tailings storage facilities existed, but that an inadequate commitment to safe storage combined with poor management was the cause of most failures. Unfortunately, despite this realization and the development of many new measures, guidelines and improved practices, tailings storage facilities have continued to fail. Furthermore, the issue of safely storing tailings may become even more challenging as the volume of waste from mines increases due to lower ore grades and as climate change brings about more intense and variable weather events.*[8]

The PolyMet/Glencore proposed tailings dam is of concern as it includes design elements that experts specifically warn against, including above ground storage of wet tailings, a cascading dam wall constructed of clay, and tailings topped with a water cover.[9] The Independent Expert Engineering Investigation and Review Panel recommends to "…eliminate surface water from the impoundment and store tailings underground as dry

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[7] IEEIRP p. 119.
[8] United Nations Environmental Program p. 10.
[9] polymetmining.com/northmet-project/mining-process/, accessed on July 10, 2018.

stack tailings,"[10] and the UN urges against high-risk construction techniques including wet tailings, water covers, and cascading dam walls.[11]

Data

This analysis is based on state and federal data for pipeline spills and other accidental releases, as well as tailings impoundment failures, for 14 out of 16 operating copper sulfide mines in the U.S. in 2010, accounting for 89% of U.S. copper production.[12] Only two active copper sulfide mines were omitted from the report due to their being in operation for less than five years, to account for the construction phase of copper sulfide mines when little or no mining is conducted.

By using data from copper sulfide mines currently operating in the U.S., this analysis is based only on mines utilizing contemporary practices currently employed by the copper sulfide mining industry.

Our statistical analysis is a conservative estimate of the risks based on the fact that more in wet climates found in northern Minnesota, spills are more likely to reach surface water and groundwater than in the arid southwest, where many of the currently operating copper mines are located:

> *Many of the currently operating copper porphyry mines are located in the arid southwest, where precipitation is limited, and communication between surface and*

[10] IEEIRP p. 120-122.
[11] United Nations Environmental Program, p. 30, 63-64.
[12] Gestring, Bonnie. *U.S. Copper Porphyry Mines: The Track Record of Water Quality Impacts Resulting from Pipeline Spills, Tailings Impoundment Failures and Water Collection and Treatment Failures*. Earthworks, July 2012 (Revised November 2012). Available: https://earthworks.org/publications/us_copper_porphyry_mines/

groundwater resources is limited. While beyond the scope of the analysis in this report, more significant impacts could be expected at mines in wetter climates, with abundant surface water and shallow groundwater, such as is the case in the Bristol Bay region. Research shows that mines with high acid generating potential and in close proximity to surface and groundwater are at highest risk for water quality impacts.[13]

In addition, this analysis uses the conservative assumption that the PolyMet/Glencore tailings dam would need to stay intact for only 500 years. According to PolyMet/Glencore, the modeling employed, "cannot predict when water treatment will no longer be necessary."[14] In spite of that uncertainty, PolyMet/Glencore uses a 500-year event horizon in its Environmental Impact Statement.[15] Since no remediation or removal is proposed for the waste products, including heavy metals such as lead, arsenic, and mercury,[16] it is more accurate to say that the proposed tailings dam would need to remain intact in perpetuity.

Statistical Analysis

The review of 14 copper mines provides 378 years total exposure; all the mines experienced spills, with a total of 175 spills and four of the mines experienced impoundment failures. Poisson regression was used to estimate rates of spills with a 95% confidence interval. The observed failure rate was 4 out of 14 mines (29%) over the 27-year interval

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13 Gestring, Bonnie, p. 5.
14 *NorthMet Mining Project and Land Exchange: Supplemental Draft Environmental Impact Statement*, November 2013, p. 90.
15 *NorthMet* 2015.
16 *NorthMet* 2015, p. 997.

(1986-2012) and this was used with a binomial distribution model to estimate the chance of impoundment failure over various time intervals.