



Tailings Basin Stability

What is being proposed to address the stability of the proposed NorthMet project tailings basin?

Engineers from the Minnesota Department of Natural Resources (MDNR) have been working with PolyMet Mining and their consulting engineers since the action was originally proposed almost ten years ago. The focus has been to assure that the designs for the Flotation Tailings Basin, the Hydrometallurgical Residue Basin, and the waste rock stockpiles all meet industry standards for long-term stability. The measure of stability is called the Factor of Safety, which is a computed value based on the basin design (slope; height; setbacks; rate of construction) and the properties of the materials used in the construction. Other items considered in the Factor of Safety include maximum precipitation events, maximum seismic events, construction errors such as over-steepened slopes, and accelerated construction schedules.

Existing tailings basin conditions have been identified through data gathered from surveys, material testing, and site exploration. In areas where the Factors of Safety for using the existing structure for proposed NorthMet project purposes falls close to or below the industry standard, PolyMet has proposed modifications to the basin designs to increase the Factors of Safety, such as:

- Increase rock buttressing to the existing dams to reinforce those areas where peat and fine tailings and slimes layers occur.
- Strengthen peat and fine tailings and slimes layers within the existing tailings basin through Cement Deep Soil Mixing prior to using the tailings basin for NorthMet tails.

Current analysis indicates that the slope stability of all tailings basin embankments and waste rock stockpiles for the proposed NorthMet project would meet, and in instances greatly exceed, the minimum acceptable Factors of Safety. The details of the design, as well as monitoring and management requirements, would be further refined for permitting under the MDNR Dam Safety Permit and the Permit to Mine.

What kinds of alternatives were considered for the proposed NorthMet project tailings basin?

The proposed NorthMet project tailings basin alternatives, shown in Final Environmental Impact Statement (Final EIS) Table 3.2-17, were screened for the Supplemental Draft EIS, and are discussed below:

- An off-site subaqueous (or underwater) in-pit disposal of tailings alternative (E5) was considered but eliminated in the Draft EIS. The Co-lead Agencies determined after independent review that off-site underwater disposal of tailings or waste rock would not have environmental benefits greater than on-site underwater disposal. In addition, this alternative was eliminated because of the added potential impacts associated with transporting tailings or waste rock off-site or

because off-site locations were insufficient in storage capacity or unavailable due to access rights.

- Thickened tailings (paste tailings) alternative (TB-1) was considered but eliminated in the Draft EIS, reconsidered post-Draft EIS, and determined not to offer significant environmental benefits when compared to the proposed NorthMet project.
- An alternative involving co-disposal of waste rock and tailings in a lined tailings basin (E14) was considered but eliminated in the Draft EIS because it was not technically feasible and its economic feasibility was uncertain.
- Several different tailings basin closure alternatives were reconsidered but eliminated during the Supplemental Draft EIS process. These tailings basin closure alternatives did not afford significant environmental benefits when compared to the enhanced engineering controls, specifically seepage collection and reverse osmosis mechanical water treatment, built into the proposed NorthMet project.
- A dry cap alternative was considered; however, under the existing model design, seepage from the basin was predicted to result in higher constituent concentrations.

Have the Co-lead Agencies considered what happened at Mount Polley?

Yes. After the close of the comment period on the Supplemental Draft EIS, but prior to publication of the Final EIS, an Independent Expert Engineering Investigation and Review panel issued a Report on the Mount Polley Tailings Storage Facility Breach (January 2015). Co-lead Agency geotechnical staff reviewed this report as part of developing the Final EIS. Although a direct comparison of Mount Polley and the PolyMet proposal is difficult because the basin designs are very different, the PolyMet tailings basin would be constructed to a significantly higher engineering and construction standard than what was used at Mount Polley.

Even though a direct comparison of Mount Polley and the PolyMet proposal is difficult, a direct comparison can be made using Factor of Safety. In the case of Mount Polley, the regulating unit of government required a Factors of Safety similar to industry standards be used at the end of project construction and in closure, but allowed for a lower Factor of Safety to be used during actual construction and basin operations.

The Mount Polley basin design called for a rock buttress to be placed against the perimeter embankment to strengthen that embankment so as to meet the required Factor of Safety. However, the rock buttress was not constructed and the Factor of Safety for the perimeter embankment fell below the already approved low standard. Approximately two months prior to dam failure, the basin, which lacked the ability to store large precipitation events, was overtopped by water resulting in the saturation and further weakening of the perimeter embankment soils. The ultimate cause of the Mount Polley Dam Failure was determined to be an unknown clay layer below the embankment, but the independent reviewers noted that if the dam had been built to the approved Factor of Safety, and the rock buttress constructed as designed, the dam would not have failed.

The 2015 Mount Polley report contained general recommendations that can be considered to reduce the risk of tailings dam failures. Environmental review of the proposed NorthMet project considered design and siting features similar to the recommendations in that report. The specific use of dry stacking technology would increase tailings basin stability. But when other site specific and environmental factors are considered, this alternative technology does not have significant environmental benefits over the proposed NorthMet project. Other factors considered included:

- Industry standard for dry stacking includes the use of a basin liner. Construction of a basin liner on the existing tailings basin has been evaluated and determined not to be feasible.
- Use of dry stack technology would require a new tailings basin to be constructed in a different location as a lined dry stack basin. A separate dry stack tailings basin would increase footprint effects of the proposed NorthMet project.
- The proposed NorthMet project addresses legacy water quality issues of the existing tailings basin while making use of the brownfield site for tailings disposal. A separate dry stack tailings basin would not address existing tailings basin legacy issues.

Finally, site specific information and design features are essential to understanding geotechnical stability of any tailings basin. The Co-lead Agencies are confident in the site specific data that has been collected for the proposed NorthMet project and that was used to model geotechnical stability. The design of the proposed NorthMet project tailings basin is sufficiently different from the Mount Polley tailings storage facility (i.e. shallower slopes; use of buttressing; incorporation of cement deep soil mixing technology) that a direct comparison cannot be made.

For more information about tailings basin stability in the Final EIS for the NorthMet Mining Project and Land Exchange, see Section 5.2.14.2.2. For more specific details on the design and stability modeling please see Geotechnical Data Package, Volume 1 (Tailings Basin) (cited in the Final EIS as PolyMet 2015I). The Flotation Tailings Management Plan (cited in the Final EIS as PolyMet 2015n) contains details of monitoring and management for the Tailings Basin. Also, refer to additional Fact Sheets about the NorthMet Mining Project and Land Exchange Final EIS:

- 1. Project and Land Exchange Overview**
- 2. What is the Environmental Review Process?**
- 3. What's Changed since the Draft EIS?**
- 4. What's Changed since the Supplemental Draft EIS?**
- 5. Supplemental Draft EIS Comment Response Process**
- 6. Effective Commenting on the Final EIS**
- 7. A Guide to the Final EIS Document**
- 8. Air Quality**
- 9. Water Quantity**
- 10. Wetlands**
- 11. Water Quality**
- 12. Wild Rice**
- 13. Mercury**

- 14. Threatened & Endangered Species**
- 15. Cultural Resources**
- 16. Land Exchange**
- 17. Reclamation & Financial Assurance**
- 18. Cumulative Effects**
- 19. Tailings Basin Stability**
- 20. Water Modeling**
- 21. Northward Flowpath**
- 22. Duration of Treatment & Financial Assurance**
- 23. Human Health**