March 2019
Regarding PolyMet Mining's NorthMet Tailings Dam Design and Safety

Background
Recent tailings dam failures in Brazil are bringing attention to the design and operation of inactive and active tailings impoundments worldwide, including in Minnesota, where a number of tailings basins exist as a result of more than 135 years of iron ore mining.

While some tailings basins may be broadly similar as to type of design, each is unique to its geographic area due to climatic and geotechnical conditions, making comparisons difficult or impossible. Moreover, application of design tools and techniques, standards for their design, construction and operation differ from state to state and from country to country, and continue to evolve with time and technological advancements.

There are hundreds of tailings basins throughout the U.S. They are built and regulated to stricter standards than what we might see in other countries, which is perhaps why the U.S. in recent history has not experienced the kinds of serious environmental and life-safety situations other countries have encountered in mining.

PolyMet's NorthMet tailings basin is a highly engineered structure that has been stable and safe for more than 50 years, and will be returned to use once copper-nickel and precious metals mining begins. It is only one of many more active and much larger iron-ore tailings basins (of similar design) in northern Minnesota that have existed safely for decades. However, *there are none that have been more studied and scrutinized and few that will match NorthMet's controls and standards.*

PolyMet Position
PolyMet evaluated the typical upstream, centerline, and downstream dam configurations for its tailings basin. Each method has benefits and risks, and in the case of centerline and downstream configurations, additional disturbance to wetlands and forest due to expanded footprints and additional need for borrow materials. We have a regulatory and moral obligation to minimize the project's environmental impact; the existing upstream dam construction was selected for that reason after it was determined it meets the state's dam safety standards.

Our tailings basin, however, remained one of the most studied aspects of the entire NorthMet Project during its 14-year environmental review and permitting process. Its design was reviewed extensively by independent, international experts during environmental review and by different experts hired by the state during permitting. *The dam was found to meet or exceed every factor of safety for dam stability.* Further, requirements imposed by the facility Dam Safety Permit and Permit to Mine and agreed to by PolyMet far exceed the standards set forth in the Minnesota Rules.

Key safety features incorporated into the permitted design include:
- Design using the worst-case scenario of tailings liquefaction;

- A rock buttress to support the upstream method of dam construction;
- Use of coarse taconite tailings as structural fill for the dam construction;
- An operations-phase emergency overflow channel and post-closure overflow channel;
- Flat slope angles (7H:1V for NorthMet slopes) and slope setbacks to further improve stability; and
- Dam construction sequencing and beach length to maintain available freeboard (the distance between the reservoir water surface and the top of the dam) even after the occurrence of an extreme rain event.

Enhancing and reusing the existing basin with upstream construction was ultimately determined by the state's experts to be a safe approach and a much more environmentally acceptable plan than disturbing untouched forest and wetlands at a greenfield site.

Brazil vs. Minnesota

One of the expert reviewers of the NorthMet tailings basin was Dr. Scott Olson, whose role in the Brazillian tailings dams and PolyMet's NorthMet tailings basin is being grossly mischaracterized by anti-mining groups.

Dr. Olson, an associate professor at the University of Illinois and a globally recognized and highly respected geotechnical consultant for the mining and heavy construction industries, did not design either of the Brazilian dams that failed. He was simply assisting Vale, an owner of both Brazillian dams, with evaluation of already-built dams and identifying repair priorities. Barr Engineering Company designed the NorthMet dam and used the Olson and Stark method to select a stable design.

Dr. Olson's *full* analysis methodology was used by Barr to analyze the PolyMet tailings basin, including a calculation for worst-case scenario liquefaction. Unfortunately, it appears that the entity that evaluated the dam in Brazil, which was neither Dr. Olson nor Barr, did not use all necessary steps in the analysis and did not consider liquefaction.

The PolyMet dams will use a 3.5H:1V slope for the rock buttress, and benches and setbacks creating an average slope above the buttress of 7H:1V. The dams in Brazil were much steeper, as steep as 2H:1V at some locations, which is just one of many reasons why it is not accurate or productive to attempt to compare the two.