October 16, 2017 VIA EMAIL

Commissioner Tom Landwehr
MN Department of Natural Resources
ATTN: PolyMet NorthMet Project
500 Lafayette Road N, Box 45
St. Paul, MN 55155-4045

Dear Commissioner Landwehr,

Thank you for the opportunity to submit comments for the NorthMet Draft Dam Safety Permits Nos. 2016-1380 and 2016-1383. These permits are a mere eight pages, but the length of the permits belies a basic truth about the proposed NorthMet Mining Project: by design, these dams are expected to hold back mine waste forever. To reiterate: earthen berms rising 250 feet above the surrounding area and constructed on top of 50 year old mine waste slurry are expected to contain 225 million short tons of powdered rock and water, and to do so indefinitely without unreasonably risking the public's health, safety, or welfare.

No mining company has ever constructed a copper-nickel tailings facility in the U.S. that did not release mine waste into the surrounding environs.[1] If history is any guide, the NorthMet facility will be no different. Nor will it be any different from the existing tailings basin on which it is to be constructed, which currently leaks 3.5 million gallons of mine-impacted waters a day to local rivers and streams.[2] The question is not if it will leak, but when. The agency's role in this question is to mitigate the risk to the public as much as possible, and to deny the permits if the risk cannot be reduced. These permits do not do that. These permits allow the use of outdated, dangerous construction techniques like upstream dam construction and fail to incorporate the current, prudent engineering practices learned from mining disasters like Mount Polley. If copper-nickel mining is to occur in Minnesota, it is irresponsible to do so at the expense of future generations. We cannot finance the jobs of today by contaminating the water of our grandchildren. We urge you to deny these permit applications or, at a minimum, incorporate permit conditions that require current best practices in mine engineering, including but not limited to a condition that requires a tailings storage design that reflects the Best Available Technologies recommended by the Mount Polley Expert Review Panel, which includes the elimination of surface water from the impoundment, the promotion of unsaturated conditions in the tailings with drainage provisions, and the achievement of dilatant conditions throughout the tailings deposit by compaction.

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[1] Letter from Thomas Tidwell, Chief of Forest Service to Neil Kornze, Director of Bureau of Land Management, U.S. Forest Serv. File Code 2670 (Dec. 14, 2016), attached as Exhibit 1.
[2] Final Environmental Impact Statement, NorthMet Mining Project and Land Exchange, Minn. Dep't of Nat. Res., U.S. Army Corps of Eng'rs, U.S. Forest Serv., 5-7 (Nov. 2015) [herinafter "PolyMet FEIS"].

Please note that we are submitting individual comments from three of our consultants: Jim Kuipers, David Chambers, and Michael Malusis. Those comments are attached to this letter as Exhibits 2, 3, and 4, and are hereby incorporated by reference. We ask that they be considered together with the comments of the undersigned organizations.

1.0 The Proposed Tailings and HRF Dams Pose Unreasonable Risks to the Public, And Are Inconsistent with Current, Prudent Engineering Practices Approved by the Mount Polley Independent Expert Review Panel

It is difficult to overstate how significant the Mount Polley tailings dam failure was to the industry as a whole, and how critical it is for our state to learn the lessons of that tragedy. The disaster occurred in an area with decades of experience in non-ferrous mining regulation, and it happened despite being designed and inspected by leading engineering firms.[3] We believe that the Department understands this significance, and it does not escape our notice that the Department consulted with a member of the Mount Polley Expert Review Panel ("Mount Polley Panel") in evaluating dam safety permit application materials for the NorthMet project. Which is why it is equally significant to us that the draft dam safety permits in many ways do not incorporate the recommendations of the Review Panel. Minnesota law is clear that permit decisions on a new dam or enlargement must be based on a determination that the proposal complies with "prudent, current environmental practice throughout its existence."[4] The recommendations of the Mount Polley Expert Review Panel clearly constitute prudent, current practices for mining, and therefore the Commissioner must either deny the permits or modify them to require compliance with the recommended practices of the Review Panel.

1.1 Wet Closure of the Tailings Facility Poses an Unreasonable Risk to the Public

The Flotation Tailings Dam that is the subject of Draft Permit 2016-1380 will contain 11.27 million short tons of slurry pumped from PolyMet's Beneficiation Plant every year.[5] PolyMet proposes a wet closure for the tailings basin, with a permanent pond on the surface that will (if successful) limit the infiltration of oxygen through the mine waste.[6] Indeed, the proposal depends on wet tailings for it to function as expected. Bentonite amended layers only function properly when saturated to a certain degree, and the long-term maintenance of the dams involves routine inspection to ensure the bentonite amended tailings are not becoming dried out.[7] These inspections and other

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[3] *See* Jim Kuipers, "Review of NorthMet Mining Project Dam Safety Permit", KUIPERS & ASSOCIATES, (Sept. 30, 2017) [hereinafter "Kuipers Dam Safety Permit Comments"], at 12, attached as Exhibit 2.
[4] Minn. R. 6115.0410, subp. 8.
[5] NorthMet Dam Safety Permit Application: Flotation Tailings Basin, prepared for PolyMet Mining, Inc., Barr Eng'g Co., 1 (May 2017) [hereinafter "PolyMet FTB Permit Application"].
[6] NorthMet Project Flotation Tailings Management Plan, PolyMet Mining, Inc., Appendix A 39 (May 15, 2017).
[7] *Id.* at 40.

long-term maintenance activities on the dam will extend into perpetuity, and if the project performs as expected, the FTB dam will impound slurry waste and a tailings pond forever.[8]

Put most simply, storing mine waste wet is risky. These risks most often come in two forms: the risk of an outright dam failure such as occurred at Mount Polley, or the risk that water treatment of mine-impacted water will be required in perpetuity, often at taxpayer expense. While the former is a low-probability, high-consequence type event, the latter is a very high-probability event with variable consequences, depending on the constituents discharged from the tailings facility.

The collapse of a tailings dam is possibly the most devastating impact that could occur at a mine site, resulting in widespread impacts that could travel and diffuse for tens or even hundreds of miles when waste spills into moving water. Many Minnesotans were uncomfortably introduced to tailings dam failures in 2014 when the impoundment at the Mount Polley dam failed catastrophically, releasing a four square kilometer sized tailings pond into Hazeltine Creek and Quesnel Lake, a drinking water source for area residents.[9] The sudden deluge scoured trees from Hazeltine Creek and turned what was a four-foot wide stream into a raging river 150-feet wide.[10] Water sampling showed that the tailings spill contaminated Quesnel Lake with copper, iron, aluminum and phosphorus.[11] But the Mount Polley mine was no fly-by-night operation. It failed despite top-notch engineering design and regulatory oversight. The dam that failed was designed by Knight Piesold, a well-respected engineering firm, and was developed using the observational method recommended by DNR's consultants in this matter.[12] At the time of failure, the impoundment was only 124 feet high, far lower than the proposed 250+ feet for the NorthMet FTB dam.[13] Despite these precautions, an investigatory review panel determined that hidden unstable layers that were not discovered during the dam's design and construction rendered the dam vulnerable to collapse.

The central lesson of the episode, then, is that there is no amount of planning or design that can eliminate the risk of dam failure. That risk is present no matter how many pages of engineering documents exist to assert the dam's safety. It also shows, however, that well-respected engineering

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[8] *Id.* at 41.

[9] Justine Hunter, B.C. Didn't Inspect Mount Polley Mine in 2010, 2011, The Globe and Mail, (Oct. 14, 2014).

[10] Mount Polley Tailings Pond Situation Update, BC Gov News (Aug. 8, 2014), https://news.gov.bc.ca/stories/friday-aug-8---mount-polley-tailings-pond-situation-update.

[11] Impact Assessment Monitoring in the Quesnel Lake Watershed After the Mount Polley Mining Company Tailings Dam Breach, BC Ministry of Environment (2014), http://www2.gov.bc.ca/assets/gov/environment/air-land-water/spills-and-environmental-emergencies/docs/mt-polley/sample-monitor/moe_impact_assessment_monitoring_in_quesnel_lake.pdf.

[12] See Knight Piesold Letter to Mount Polley Mining Corporation, February 10, 2011, attached as Exhibit 5.

[13] Independent Expert Engineering Investigation and Review Panel, Report on Mount Polley Tailings Storage Facility Breach, MT. POLLEY INDEP. EXPERT INVESTIGATION AND REV. REP. 5 (Jan. 30, 2015), https://www.mountpolleyreviewpanel.ca/sites/default/files/report/ReportonMountPolleyTailingsStorageFacilityBreach.pdf [hereinafter "Mount Polley Panel Report"], attached as Exhibit 6; Flotation Tailings Basin North Dam Typical Cross Section Drawing No. FTB-009, NorthMet Project Flotation Tailings Basin Permit Application Support Drawings, Flotation Tailings Management Plan, Barr Eng'g, Attachment A (May 15, 2017).

can be overcome by mismanagement at the actual dam site. When Knight Piesold, the engineer of record, withdrew from ongoing operations in 2011, it warned the mine operator that the tailings pond was "getting large."[14] This warning was apparently ignored, as government regulators repeatedly advised the mine operator in subsequent years that effluent levels were too high.[15]

The failure of the Mount Polley dam in 2014 is perhaps the most well-known of its type, particularly in Minnesota, though it was overshadowed by the even more devastating Samarco disaster that occurred a year later. When the tailings dam at the Samarco iron mine failed in 2015, the rushing river of mine waste over 30 feet high laid ruin to the surrounding countryside, killing 19 and destroying villages. A year later, the river still runs red from mine contamination.[16] The tragedy has hit the mining companies hard: Samarco failed to make payments on debt and requested debt restructuring,[17] while BHP Billiton, one of the mine's owners, announced a record loss of $6.4 billion.[18] The mine owners and operator have signed an agreement with the Brazilian government for socioeconomic and environmental recovery work worth over $6.5 billion over 15 years.[19]

Perhaps most relevant to the instant permits, however, is the investigation into the cause of the disaster. An expert panel (including Steve Vick, who also served on the Mount Polley expert panel) concluded that structural damage to the starter dike resulted in increased saturation of the tailings and the encroachment of saturated slimes underneath the impoundment.[20] This saturated state precipitated a liquefaction event that rendered the dam unstable. Seismic shocks prior to the collapse may have been a contributing factor.[21]

These features are of course present in the dam design noticed for permitting by the DNR. The proposal would construct a dam with the upstream method on top of existing LTVSMC slimes (see discussion below). The proposal's efficacy is dependent on the proper functioning of the bentonite layer at closure, to prevent saturation of the tailings underneath the impoundment. As described below, that efficacy has not been demonstrated. Permitting a dam when the central determinants of its safety are unknown is clearly not protective of the public health, safety and welfare. It is for these reasons that wet closures are increasingly recognized as inherently risky. Mine

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[14] Exhibit 5.
[15] Mount Polley Tailings Pond Situation Update, BC Gov. News (Aug. 8, 2014), https://news.gov.bc.ca/stories/friday-aug-8---mount-polley-tailings-pond-situation-update.
[16] Dom Phillips, Samarco Dam Collapse: One Year On From Brazil's Worst Environmental Disaster, The Guardian (Oct. 15, 2016), https://www.theguardian.com/sustainable-business/2016/oct/15/samarco-dam-collapse-brazil-worst-environmental-disaster-bhp-billiton-vale-mining.
[17] *Id.*
[18] *Id.*
[19] *Id.*
[20] See Demonstrative Animation, The Fundao Tailings Dam Investigation, Fundao Investigation, (Aug. 29, 2016), http://fundaoinvestigation.com/demonstrative-animation/.
[21] *Id.*

experts "are concerned that flooded impoundments may create a risky legacy,"[22] primarily because conventional slurry tailings impoundments fail at a rate of 2 to 5 "major" failure incidents per year.[23]

1.2 Wet Closure Does Not Reflect Current, Prudent Environmental Practice

As detailed in the attached comments of Jim Kuipers and David Chambers, for the reasons identified above, the Mount Polley Panel identified underground or backfilling of pits and filtered tailings technology as the Best Available Technology (BAT) for tailings storage facilities, and specifically cautions against wet closures.[24] For the closure of active impoundments, the Panel recommended adoption of three design principles: no surface water; unsaturated conditions in the tailings, with drainage; and compaction of drained tailings to achieve a long-term, static stability condition.[25] The report is clear that anything less is a hazard: "Mount Polley has shown the intrinsic hazards associated with dual-purpose impoundments storing both water and tailings."

These conclusions represent the culmination of several decades of knowledge regarding the long term safety of tailings facilities. Maintaining the stability of an impoundment of slurry over hundreds of years is simply too great an engineering and financial challenge:

> The more traditional closure configuration for tailings impoundments has been to draw down water ponds as completely as possible, to reduce the potential for dam failure by overtopping or erosion. To raise water levels in impoundments formed by high dams could present considerable long term risk. One of the reasons that closed tailings impoundments have traditionally proven to be generally more safe, from the physical stability perspective, than operating impoundments is the relatively more "drained" condition of closed impoundments that do not include a large water pond. The flooded closure scenario represents an "undrained" condition that does not allow this improvement in physical stability to develop, so the risk does not decrease with time.[26]

As a result, the current, prudent environmental practice is either filtered tailings storage or subaqueous disposal. Mine experts are unequivocal: "the surest, safest and most cost-effective solution to prevent [acid rock drainage] is sub-aqueous disposal in a lake or the ocean."[27] If that

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22 Michael Davies, et al. Design of Tailings Dams and Impoundments, 5 (2002), http://www.infomine.com/library/publications/docs/Davies2002b.pdf [hereinafter "Davies et al. 2002"], attached as Exhibit 7.
23 Michael Davies & Stephen Rice, An Alternative to Conventional Tailing Management – "Dry Stack" Filtered Tailings (2004), http://www.infomine.com/library/publications/docs/Davies2004.pdf [hereinafter "Davies & Rice 2004"], attached as Exhibit 8.
24 Mount Polley Panel Report at 121-122 (Exhibit 6).
25 *Id.* at 121.
26 Davies et al. 2002 (Exhibit 7).
27 *Id.*

option is not available, slurry tailings must at a minimum be drained and compacted at closure to minimize risk to the public.[28]

Although Minnesota regulations do not define what constitutes "current, prudent engineering practice," (or "prudent, current environmental practice"[29]) our laws do make clear that alternative technologies offering significant environmental benefits may not be rejected solely for economic reasons.[30] These laws establish that "current, prudent engineering practice" and the Best Available Technology as determined by the Mount Polley Expert Panel are one and the same.[31] And it is amply evident that dry stack tailings storage offers considerable environmental benefits, in terms of both discharges of mine-impacted water and in terms of long-term tailings stability.

> Dry stacked tailings facilities have some tremendous potential environmental advantages over impounded slurried tailings largely because the catastrophic physical failures that define tailings management to non-supporters of the industry cannot occur. Moreover, leachate development is extremely limited due to the very low seepage rates possible.[32]

Dry stacking also offers the best chance of eliminating the need for perpetual water treatment, as seepage is greatly reduced if not eliminated.[33]

As the Mount Polley panel noted, technical feasibility is no impediment to filtered tailings storage. It is a "demonstrated technology . . . well-known in the industry."[34] The process involves dewatering tailings before storage, which allows it to be compacted to enhance stability:[35]

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28 Mount Polley Panel Report at 121-122 (Exhibit 6).
29 For the purposes of this section, the two terms are used interchangeably.
30 Minn. Stat. § 116D.04, subd. 6, for instance, prohibits the state from taking any action, including issuance of a dam safety permit, that significantly affects the quality of the environment or from issuing a permit that "is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state," unless there is "no feasible and prudent alternative to issuance of the permit consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution impairment or destruction. Economic considerations alone shall not justify such conduct." *See also* Minn. Stat. § 116B.04 (establishing that "economic considerations alone shall not constitute a defense" to a claim under the Minnesota Environmental Rights Act).
31 See 33 U.S.C. 1314(b)(2)(B) (describing "best available technology" as taking into account "the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate").
32 Exhibit 8 at 3.7.
33 Michael Davies, Filtered Dry Stacked Tailings – The Fundamentals, Proceedings Tailings and Mine Waste, Vancouver, BC, Nov. 6-9, 8 (2011) http://www.infomine.com/library/publications/docs/davies2011.pdf [hereinafter "Davies 2011"], attached as Exhibit 9 (noting that "if there is proper compaction and maintenance of target moisture contents, seepage is negligible.").
34 Mount Polley Panel Report at 122 (Exhibit 6).
35 *Id.*

> Filtered tailings emerge from the process facility within a prescribed range of moisture contents . . . The tailings are then transported by conveyor or truck and then placed, spread and compacted to form an unsaturated, dense and stable tailings "stack" (often termed a "dry stack") requiring no dam for retention with no associated tailings pond.[36]

The process has been used for tailings quantities well in excess of the roughly 27,000 cubic yards of in-place mine waste that will be produced by the NorthMet project every day.[37] Some new operations will be producing filtered tailings at a rate of about 35,000 cubic yards a day.[38]

Filtered tailings are particularly appropriate for cold climates, where water handling is very difficult in winter, and in situations when the operating and closure liabilities exceed the incremental cost increase of developing a dry stack.[39] For the NorthMet project, water treatment costs at the mine's closure are upwards of $400 million.[40] We find it very concerning that the company would choose not to utilize dry stacking due to a larger upfront expense,[41] when the alternative is a literal eternity of extremely expensive water treatment. Like many others, we assume that this choice reflects an alarming assumption that those long-term costs will somehow never materialize, or at least never materialize for the company receiving permits.

Aside from increased stability and a quicker steady state condition, filtered tailings storage offers significant benefits at the mine's closure. Because the tailings have already been dewatered, there is no need for water treatment at closure:[42]

> The lack of a tailings pond, very low (if any) appreciable seepage from the unsaturated tailings mass and general high degree of structural integrity allows dry stacks to present the owner/operator with a comparably straight forward and predictable facility closure in comparison with most conventional impoundments.[43]

And because the end product more closely resembles typical terrain, "one of the main advantages of dry stack tailings over other tailings management options is the ease of progressive reclamation and closure of the facility."[44] This benefit is significant, as it allows "re-vegetation of the tailings slopes

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36 Davies 2011 at 3 (Exhibit 9).
37 PolyMet FTB Permit Application at 1.
38 Mount Polley Panel Report, supra note 13, at 122 (Exhibit 6) (please note that conversion from metric tonnes to cubic yards is an estimate, as the exact conversion rate is not provided in the report itself).
39 Davies 2011 (Exhibit 9).
40 See NorthMet Permit to Mine Application, prepared for PolyMet Mining, Inc., Foth Infrastructure & Env't, LLC & Barr Eng'g Co., Appendix 15, Tbl. 1 (Nov. 2016) (reflecting costs for Wastewater Treatment Facility Pit Flushing Costs and Wastewater Treatment Plant Gallons Treated Costs).
41 Presumably, since no explanation for the decision has ever been given by the company, to our knowledge.
42 Davies 2011 at 8 (Exhibit 9) (noting that "if there is proper compaction and maintenance of target moisture contents, seepage is negligible.").
43 *Id.*
44 *Id.*

and surface as part of the annual operating cycle."[45] Filtered tailings storage also allows for the use of less stable foundation conditions, because the dewatered and compacted tailings stack is inherently more stable than a saturated impoundment.[46] This would therefore solve the problem identified by DNR's consultants, whereby the existence of peat at the buttress foundation would raise the risk of dam failure.[47]

But perhaps most significantly, filtered tailings storage would eliminate the possibility of a catastrophic dam failure of the type that occurred at Mount Polley. "Filtered tailings placed in dry stacks are essentially immune to catastrophic geotechnical 'failure' and can be readily designed to withstand static and seismic forces."[48] Indeed, filtered tailings storage would eliminate the need for an impoundment of any kind. Dry stack tailings are frequently (if not always) capped at closure with a cover material to resist erosion, prevent water infiltration and to provide a growth media for vegetation during reclamation.[49] The end state of reclamation for dry stack tailings, therefore, is a more natural landscape that minimizes oxidation of mine waste and the need for water treatment, while the end state for the proposed tailings facility is a saturated pile of mine waste topped with a pond and held in place by an earthen berm for eternity.

Even if dry stack tailings storage were to prove unfeasible due to mine waste characteristics, partial dewatering of the mine waste offers a significant proportion of the benefits of dry stacking. The reduction in the amount of water stored behind the impoundment substantially reduces the risk of dam failure. As the Mount Polley Panel noted, the quantity of water impounded by a tailings dam is directly correlated with the amount of tailings released during a breach event. The Mount Polley Report notes that "[h]ad there been less water to sustain [fluvial processes], the proportion of the tailings released from the TSF would have been less than the one-third that was actually lost."[50] It is conversely true that the reduction of water impounded during operations and at closure produces a corresponding drop in the amount of tailings that would be released during a dam breach. In the case of Mount Polley, the level of water impounded may have been the difference between disaster and what could have been a less serious event. As the report notes, "Had the water level been even a metre lower and the tailings beach commensurately wider, this last link [in the chain of failures] may have held until dawn the next morning, allowing timely intervention and potentially turning a fatal condition into something survivable."[51]

In short, the regulatory directive that dam safety permits must be based on current, prudent engineering and environmental practice, when viewed in light of statutes related to environmentally preferable alternatives, requires that the NorthMet FTB and HRF facilities utilize the Best Available

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45 *Id.*
46 *Id.*
47 Review Team Comments Memorandum from Dick Van Zyl, Steve Gale, Cecilio Olivier, and Stuart Grubb to Jason Boyle, May 15, 2017, at 4.
48 Davies & Rice 2004 (Exhibit 8).
49 *Id.*
50 Mount Polley Panel Report at 137 (Exhibit 6).
51 *Id.*

Technology for tailings storage. Drawing on the hard lessons of past mining disasters, expert panels of mine engineers have concluded that this Best Available Technology is dry tailings storage, not conventional slurry impoundments. By dewatering and compacting the tailings, a redesigned facility would eliminate the risk of catastrophic tailings dam failures and eliminate the need for water treatment in perpetuity.

1.3 The Department Unreasonably Refused to Consider Dry Stack Tailings as an Alternative to Wet Closure with Slurry Dams

The Department has long known that wet closures are inherently risky. DNR's Dam Safety Engineers have for years warned that wet closures pose serious risks to the public and to the taxpayer:

> [The] Dam Safety [Division] has numerous concerns with this project because the tailings dams must function properly for an extended period of time – we've heard on the order of 900 years. Our first concern is whether the PolyMet tailings will form a structurally sound base to support the perimeter dams. Our second concern is that the proposed wet cap will significantly increase the potential for a dam failure, and will result in costly monitoring and maintenance over the life of the project (including monitoring costs to DNR for 900 years).[52]

These concerns were shared by DNR's consultants, who urged the serious consideration of environmentally preferable alternatives to wet closure. Spectrum Engineering Engineer Don Sutton expressed his concerns to DNR's Dam Safety Engineers in an email:

> If seepage collection or treatment is or might be necessary for an indefinite time with a wet closure, then what is the benefit of wet closure? The wet closure is riskier, has more uncertainties, and may be more expensive because it will require more perpetual care and maintenance than a dry closure. I suggest that PolyMet investigate some alternatives . . . I don't like wet closure, because it is not a permanent closure. I believe it will eventually fail and release the sulfates.[53]

Mr. Sutton urged an exploration into the comparative economics of the long term costs associated with wet vs. dry closures:

> I share [the Dam Safety Engineer's] wet closure concern and have additional concerns related to the long term tailings wet closure uncertainties and risks . . . If there is a reasonable risk that wet closure won't prevent oxidation or sulfates for 900 years and if perpetual water collection and treatment will be needed, then why not investigate some dry closure options and compare the long term O&M costs and long term risks of each alternative? Perhaps there is a dry closure alternative that is

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[52] DNR Dam Safety Senior Engineer Dana Dostert, Geotechnical/Geochemical Questions Related to PolyMet Tailings, January 31, 2012, attached as Exhibit 10.
[53] Email of Don Sutton to Dana Dostert, January 23, 2012, attached as Exhibit 11.

> more economical and less risky when perpetual maintenance O&M are considered. At some point, the cost of the risk will need to be assessed . . . I envision that PolyMet's reclamation plan could work for a while, but don't see how it will function forever without falling apart unless it is continuously maintained; which is a major leap of faith . . . I don't like the wet closure, because it is not a permanent closure. I believe it will eventually fail and release the sulfates.[54]

Despite the fact that Spectrum was hired by DNR to provide technical consultation on a matter with which it did not have any experience,[55] these very clear recommendations appear to have been ignored by the Department.

Mr. Sutton's email was written before the Mount Polley disaster. Since then, the investigation into that disaster persuaded the Expert Review Panel to conclude that wet closures were inherently risky (see discussion in section 1.1). When those conclusions were published during the environmental review process, citizens and advocacy groups (included the undersigned organizations) urged the Co-Lead Agencies to consider dry stacking as an alternative to the proposed slurry impoundment, specifically referring the Agencies to the very clear-cut recommendations of the Mount Polley Review Panel. This suggestion was summarily dismissed in a single paragraph. The Agencies responded that dry stacking would require a basin liner, which would not be feasible on the existing LTVSMC tailings basin.[56] The Agencies did not clarify why they believed the existing tailings basin was a stable site for a new dam, but not for a basin liner, especially since their technical consultants have suggested that lining the existing tailings might be feasible.[57] The response also presupposes that the LTVSMC site is the only suitable location for dry stacking, and there is no indication that a search for alternate sites was undertaken, despite the clear statutory mandate to do so.[58] The Agencies responded also that dry stacking would require a new location, which would increase footprint effects of the project, and that dry stacking would not address the legacy water quality issues associated with the existing LTVSMC tailings basin.[59]

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54 *Id.*

55 Dana Dostert, Exhibit 10 ("Dam Safety has experience with tailings dams that are constructed from the residue from the taconite industry, but has no experience dealing with tailings that will be derived from minerals in the Duluth Complex.").

56 See PolyMet FEIS at Appendix A, Response to Comments on the DEIS for the NorthMet Mining Project and SDEIS for the NorthMet Mining Project and Land Exchange, A-315 (Nov. 2015).

57 *See* Exhibit 11 (Sutton-Dostert email) ("Perhaps, rather than trying to prevent oxidation, there might be a way to accelerate the oxidation to minimize the collection and treatment time. Consider installing a leachate collection system in the taconite tailings basin before the new tailings are added. This might entail putting the bentonite on the existing surface and installing some type of under drain collection system before the tailings are placed on top.").

58 See Minn. Stat. § 103G.297, subd. 3 (permit for control or use of waters for copper-nickel mining may be granted only if the commissioner determines that other feasible and economical methods of mining are not reasonably available); Minn. R. 6115.0410, subp. 8 (approval or denial of dam permits shall be based on a showing of lack of other suitable feasible and practical alternative sites, and economic hardship which would have a major adverse effect on population and socioeconomic base of the area affected).

59 *Id.*

These responses are borderline *non sequiturs*. An independent panel of mine engineers concluded that, based on the historic tragedies of tailings dam failures, it was an unreasonable risk to impound slurry waste in perpetuity, but the Agencies would not consider a dry alternative because it would increase the footprint of the proposed project. It should go without saying that the environmental impact of a dry stacked facility's footprint and the impact of a conventional slurry tailings impoundment failure are not the same (setting aside the even more obvious fact that filtered tailings result in a lesser footprint than conventional slurry tailings impoundments).[60] Furthermore, the impacts of a dry stacked footprint could potentially be minimal. Unlike an open-pit mine, where some impacts on wetlands, streams and other natural features may be unavoidable due to the precise location of a mineral deposit, a dry-stack tailings facility has more flexibility when it is sited. The Department is in fact required to investigate potential sites for a dry-stack facility that could minimize impacts.[61] Such possibilities could include the excavated pits or other brownfield sites near the LTVSMC plant. They could also include the currently proposed HRF site, which could be expanded to accommodate the filtered tailings in addition to the hydromet process residues. One of the virtues of dry stacking is that dewatered tailings may be transported by truck.[62]

Moreover, it is unreasonable to eliminate a vastly preferable alternative because it would not address another company's legacy pollution. The very purpose of dry stacking is to avoid turning a private company's pollution into public legacy pollution by reducing or even eliminating the need for perpetual water treatment after the mine has closed, and yet the Agencies refused to consider this alternative due to a concern that another company's legacy pollution would not be cleaned up.[63] In effect, in choosing PolyMet's proposal to treat the LTVSMC legacy pollution with seepage controls, the Agencies vastly increased the risk that PolyMet's new facility will become a legacy liability requiring perpetual water treatment. Rather than trade one form of pollution for another, the Department should require responsible mining that eliminates the need for perpetual water treatment through dry stacking.

1.4 Upstream Dam Construction – Particularly On Top of a Unpermitted Legacy Tailings Site – Is Inherently Unsafe and Threatens the Public Safety and Welfare

The method that PolyMet has proposed to use to construct its Flotation Tailings Basin, namely the upstream construction method, is the riskiest but cheapest possible option. The collapse or major breach of the tailings dam has the most potential to cause widespread destruction of all mining operations. Recent reports demonstrate that the risk of a tailings dam collapse is not nearly as remote as PolyMet suggests. Two hundred and fourteen tailings dams have had failures or accidents

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[60] *See, e.g.,* Davies & Rice 2004 (Exhibit 8) (noting that filtered tailings are a promising candidate for storage options where space is limited, "as filtered tailings result in a lesser footprint than for slurried tailings.").

[61] Minn. Stat. § 103G.297, subd. 3; § 116D.04, subd. 6; Minn. R. 6115.0410, subp. 8.

[62] Davies 2011 (Exhibit 9).

[63] We note also that PolyMet would still take possession and legal responsibility for permitting at the LTVSMC site. Discharges from the tailings basin would be required to meet state water quality standards and other state and federal environmental laws regardless of whether PolyMet uses it as a disposal site in any event.

since 1940.[64] Since 1960, "serious" and "very serious" tailings dam failures have occurred with greater frequency.[65] As copper grades have dropped over time, with a corresponding increase in mine waste and decrease in profit margins, the frequency of tailings dam failures has increased dramatically.[66] Very large releases of mining waste occur even at relatively small mines, such as during the Mount Polley mining disaster.[67] Many of these failures occur at facilities using upstream dam construction techniques. Upstream dams are considered "unforgiving structures," and represent up to 66% of global tailings dam failures.[68] Moreover, the cost of cleanup for a catastrophic failure averages $543 million.[69] This dollar value is beyond the capacity of most mining companies to cover. Furthermore, it is not required that the risk of a tailings dam collapse be included in the financial assurance package.[70]

Recent studies and articles discuss how critical the process of statistical analysis of tailings dam failures is when evaluating the potential for a collapse at any given mine:

> Having something more like "actuarial data" to refer to is important in understanding the potential magnitude of loss from an individual dam or a permitting districts portfolio of dams and TSFs [Tailings Storage Facilities]. With such low frequency high severity losses we can never assign risk to an individual TSF based on its design and receiving environment parameters. Unless it has an identified flaw that puts it at near certain risk of imminent failure, we can't say whether a given dam "will" fail. We can only say what the consequence would be in economic terms if it failed.[71]

Minnesota statutes and administrative rules call for certain factors to be taken into account by both the permit applicant and the permitting agency; the primary purpose of these regulations is to "best provide for public health, safety, and welfare."[72] Namely, the permit application must be based on substantial evidence[73] and the dam must be "reasonable, practical, and . . . adequately protect public

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64 Lindsay Newland Bowker & David Chambers, The Risk, Public Liability, and Economics of Tailings Storage Facility Failures, 4 (2015) [hereinafter, "Bowker & Chambers 2015"], attached as Exhibit 12.
65 *Id.* at 4.
66 Lindsay Bowker and David Chambers, *In the Dark Shadow of the Supercycle: Tailings Failure Risk & Public Liability Reach All Time Highs*, August 17, 2017, attached as Exhibit 13.
67 *Id.* at 2.
68 Flavio Fonseca do Carmo, et al., Fundao tailings dam failures: the environment tragedy of the largest technological disaster of Brazilian mining in global context. 15 Perspectives on Ecology and Conservation 145-151 (July 2017) [hereinafter "Fonseca do Carmo, et al. 2017"], attached as Exhibit 14.
69 *Id.*
70 Minn. R. 6132.1200 (financial assurance must include funds for "reclamation activities" and "corrective action . . . if noncompliance with design and operating criteria in the permit to mine occurs."). Although the draft permits state that environmental liability insurance shall be acquired to cover dam failure, no policy has been procured and thus nothing can be said about the adequacy of such insurance coverage.
71 Bowker & Chambers 2015 at 4 (Exhibit 12).
72 Minn. R. 6115.0300; see also Minn. Stat § 103G.315, subd. 6.
73 Minn. Stat. § 103G.315, subd. 2.

safety and promote public welfare."[74] The permit applicant bears the burden of proving the dam will protect the public.[75] Finally, that "[a]pproval or denial [of the permit] shall be based on the potential hazards to health, safety, and welfare of the public and the environment including probable future development of the area downstream."[76]

There is a plethora of evidence that upstream dam construction is unsafe and unsound, posing a very high risk to surrounding communities and the environment.[77] This form of dam construction has been banned in other countries because of its tendency towards failure.[78]

Dr. David Chambers states the following on this matter:

> Safety should be the prime consideration in the design, construction, operation, and closure of a dam, whether this be a water supply reservoir or a tailings dam . . . Centerline and downstream-type construction, even though it is also done in stages like upstream, depends only on materials that are sized, placed, compacted, and subsequently tested for support of the sequential stages. When tailings are hydraulically spigotted into the impoundment, their placement and water content are not uniform. There is no practical way to test the characteristics of the tailings material to assure that it is subsequently drained of excess water after hydraulic placement, and that is has the consistency and density assumed by the design modeling.[79]

Perhaps more worrisome is the fact that

> [i]n tailings dam accidents we do not see a preponderance of one or two failure causes dominating. What we see is that the number and distribution of failure type is remarkably similar. That is, overtopping, seismic failure, foundation issues, internal seepage, slope instability, and structural failure all have similar number-of-failure profiles for both active and inactive tailings dam failures (Bowker & Chambers 2016).[80] This strongly suggests there is something more fundamental than the inability to deal with the causes of one or two failure types.[81]

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[74] Minn. Stat. § 103G.315, subd. 3.
[75] Minn. Stat. § 103G.315, subd. 6.
[76] Minn. R. 6115.0410, subp. 8 (emphasis added).
[77] See, e.g., Mount Polley Panel Report (Exhibit 6); David Chambers, "Comments on the Final Environmental Impact Statement (FEIS) NorthMet Mining Project and Land Exchange", CTR. FOR SCIENCE IN PUB. PARTICIPATION, (Dec. 2015) [hereinafter "Chambers FEIS Comments"], attached as Exhibit 15.
[78] Chambers FEIS Comments at 8 (Exhibit 15).
[79] Chambers, "Comments on Draft Dam Safety Permit Numbers 2016-1380, Flotation Tailings Basin, and 2016-1383, Hydrometallurgical Residue Facility", CTR. FOR SCIENCE IN PUB. PARTICIPATION, 1 (Oct. 4, 2017) [hereinafter "Chambers Draft Dam Safety Permit Comments"], attached as Exhibit 3.
[80] Lindsay Newland Bowker & David M. Chambers, Root Causes of Tailings Dam Overtopping: The Economics of Risk & Consequence, INT'L SEMINAR ON DAM PROTECTION AGAINST OVERTOPPING, PROTECTIONS 2016, Ft. Collins, CO (Sept. 2016), attached as Exhibit 16.
[81] Chambers Draft Dam Safety Permit Comments at 2 (Exhibit 3).

He supplements these concerns by saying that "[t]he only reason to use both centerline and upstream construction, over a conventional downstream-type approach, is to save money."[82] The Mount Polley Independent Expert Review Panel ("the Panel") has clearly stated that cost should not be the determining factor in constructing a tailings basin.[83]

Jim Kuipers notices that some of these shortcomings come from the way the regulations are written, and that by not taking into account many of the factors other states and countries have into their approaches to safety in construction and operation, the proponents of such facilities fall short of the engineering safety standards.[84] This increases the risk for dam failure and the potential for catastrophic destruction. We suggest, therefore, that the term "prudent, current environmental practice" must include more stable alternatives to upstream construction.

As noted above, wet closure heightens concerns posed by upstream construction and increases the risk of dam failure. First, existing water means that the tailings, an integral part of the proposed foundation, will be saturated either partially or fully, and thus will have little to no "weight-bearing capacity under seismic loading."[85] Thus, the stability will be very weak, and the distribution will be uneven. Second, "water remaining on and in the tailings acts as a deadly mobilizing agent should a catastrophic failure occur."[86] This means that the tailings will escape much quicker and cause more damage in a shorter period of time than if they were dry.

1.4.1 Slimes used in the dam liner:

The proposed dam construction violates rules of prudent engineering and environmental practice because the dam is underlain with slimes and fine tailings. As he discusses the dangerous nature of the type of the upstream tailings basin, Dr. David Chambers references an article authored by three experts on tailings basins. This article lays out ten rules for constructing a tailings basin – he includes the following excerpt in his comments:

> It is also important to note that these rules are not options and are not interchangeable with alternative concepts of soil mechanics. These rules exist based on the fundamentals of soil behavior, the experience of numerous tailings dam failures and the experience of well-managed facilities that perform better than intended. Of the 10 rules, a "score" of 9/10 will not necessarily have a better outcome than a 2/10, as any omission creates immediate candidacy for an upstream tailings dam to join the list of facilities that have failed due to ignoring some or all of the rules.[87]

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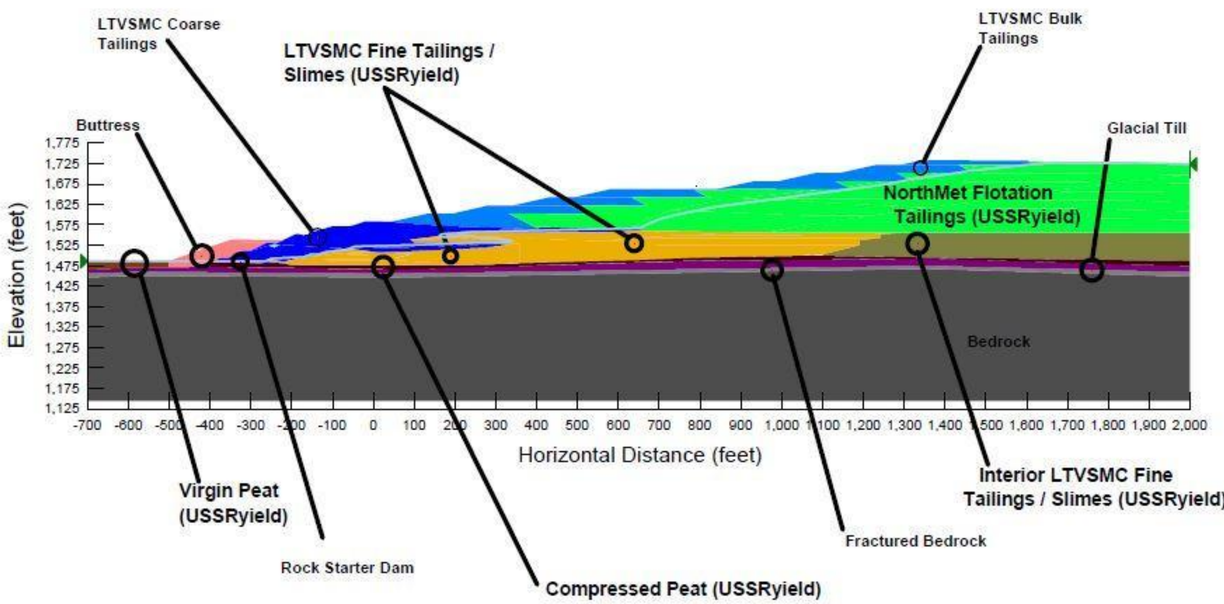
82 *Id.* at 1.
83 Mount Polley Panel Report at 125 (Exhibit 6).
84 Kuipers Dam Safety Permit Comments at 2 (Exhibit 2).
85 *Id.*
86 *Id.*
87 Chambers FEIS Comments at 8 (Exhibit 15).

Dr. Chambers says that because the proposed PolyMet FTB dam plans to incorporate tailings slimes in its liner, it violates rule number two, which states that "[t]he dam slope must not be underlain by tailings slimes . . ."[88]

As seen in the figure below, from the Geotech Data Package, the NorthMet dam will be built on a foundation of LTVSMC slimes and fine tailings. This scenario was a contributing factor to the devastating tailings dam collapse at the Samarco mine in Brazil, which killed 19 people. The Samarco Expert Panel Report concluded that after placing the "embankment directly over the previously-deposited slimes," the "slimes beneath the embankment were responding to the increasing load being placed on them by the rising embankment," thereby creating "all of the necessary conditions for liquefaction triggering."[89]



Large Figure 12. Cross-Section F Schematic of USSA Conditions

Reproduction of Large Figure 12 from Geotechnical Data Package Vol. 1 – Flotation Tailings Basin, Appendix B to May 5, 2017 Dam Safety Application for Flotation Tailings Basin Dam.

As noted below, DNR staff has expressed this same concern for years, but this risky design feature persists, in clear violation of the law's directive that dam safety permits be based on substantial evidence.

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88 *Id.*

89 *Report on the Immediate Causes of the Failure of the Fundao Dam*, Fundao Tailings Dam Review Panel, at ii [hereinafter "Fundao Panel Report"], attached as Exhibit 17.

1.4.2 Dam Classification:

Both the FTB and the HRF should be classified as Class I dams. Dr. Chambers states that because both facilities' dams pose a very high risk and with regard to "environmental and economic destruction" should either of them fail, they both need to be "classified at the highest hazard category of risk."[90]

Jim Kuipers notes that hazard classifications aside, there are a number of things that the dam classifications do not take into account. Among them are the proximity to population centers, and the number of people that can potentially be displaced or harmed if the dam were to fail.[91] This skews the hazard classification of these facilities; not many people tend to live in close proximity of these facilities, and thus the potential impact that dam failure might have on the number of people displaced or killed is lower.[92] This in turn lowers the hazard classification; thus it is "often necessary to be on the conservative side when applying dam classifications."[93] Furthermore, he says that the work that he and his group conducted found the explanation PolyMet gave, namely that "[t]he FTB dams can be categorized as Class I or Class II dams[]"[94] "highly concerning".[95] Mr. Kuipers says that this conclusion

> [S]uggests the design engineer has not taken into account all failure modes that can cause a catastrophic dam breach, many of which are independent design factors of safety. Similarly, the recent Mount Polley and Samarco (Brazil) TSF catastrophic failures were considered to "unlikely," if not impossible, until they occurred. In our experience and professional judgment a more accurate portrayal would be to consider all potential failure modes and identify TSF failure as "possible" and would likely lead to highly significant safety, environmental and economic consequences, and for that reason the TSF should be classified as Class I.[96]

Each of the dams has the potential to cause widespread environmental destruction should either of them fail. This potential harm exists addition to the potential harm facility failure could bring to the people living within the immediate proximity of each of the facilities, or those living downstream. As a result of this potential, both facilities should be classified as Class I.

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90 David Chambers Draft Dam Safety Permit Comments at 3 (Exhibit 3).
91 Kuipers Dam Safety Permit Comments at 3 (referencing work conducted by the Canadian Dam Association) (Exhibit 2).
92 *Id.*
93 *Id.* at 4.
94 Kuipers Dam Safety Permit Comments at 16 (Exhibit 2) (quoting NorthMet Dam Safety Permit Application: Flotation Tailings Basin, prepared for PolyMet Mining, Inc., BARR ENG'G CO. (May 2017) (emphasis added).
95 Kuipers Dam Safety Permit Comments at 10 (Exhibit 2).
96 *Id.* at 16.

1.5 PolyMet conducted an insufficient Dam Break Analysis contrary to regulatory requirements.

The Dam Break Analysis prepared by Barr Engineering for PolyMet is grossly inadequate. Minnesota statutes and rules require the permit application to be based on "substantial evidence";[97] as is explained below, PolyMet has not met this burden, especially with its thirteen-page Dam Break Analysis (only seven-and-a-half of which comprises the actual analysis).[98] For a project of this stature, such an analysis needs to be more detailed and use current information.

1.5.1 PMP and PMF values:

In the course of determining the potential for heavy rainfall and possible flooding, Barr Engineering conducted hydrologic models using the Probable Maximum Precipitation (PMP) and Probably Maximum Flood (PMF). The model "computed runoff from the 72-hour Probable Maximum Precipitation (PMP) storm event." [99] This event was chosen because it allows for the "estimation of worst-case flooding in Trimble Creek," which is a tributary of the St. Louis River.[100]

The PMP is described as follows:

> PMP values are, in principle, most dependent upon atmospheric moisture, transport of moisture into storms, persistent upward motion, and strong winds where orographic uplift is important. . . . The general approach, using data and physical judgment, is to estimate the precipitation that would occur if all the relevant factors in a particular place and situation achieved their optimum values simultaneously and remained in place for the specified duration over the basin area.[101]

The assumed PMP used is "32.2 inches for the 10-square mile watershed, based on the Hydrometeorological Report number 51 . . . ."[102] Furthermore, the storm runoff from the FTB was calculated using this same method, but "the volume of runoff from the storm event was not routed downstream." PolyMet added, "[s]ince the FTB was designed to hold runoff from the 72-hour PMP event, it was assumed that the total runoff volume from the FTB direct watershed was added to the open water in the FTB and there was no discharge downstream."[103] This assumption is problematic looking to the future as climate change intensifies and changes some of the precipitation patterns.

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97 Minn. Stat. § 103G.315, subd. 2.
98 Dam Break Analysis, NorthMet Dam Safety Permit Application: Flotation Tailings Basin, prepared for PolyMet Mining, Inc., BARR ENG'G CO., ATTACHment H (May 2017) [hereinafter "FTB Dam Break Analysis").
99 *Id.* at 3.
100 *Id.*
101 Kenneth E. Kunkel, et al., Probable Maximum Precipitation and Climate Change, 40 GEOPHYSICAL RESEARCH LETTERS 1402, 1402 (2013), http://onlinelibrary.wiley.com/doi/10.1002/grl.50334/epdf, attached as Exhibit 18.
102 *Id.*
103 *Id.*

Scientists expect that this rise in global temperature will result in a rise in evaporation and atmospheric water vapor content.

> A probable consequence is the intensification of the hydrologic cycle and PMP over land and ocean. The effect of this intensification on changes in PW_{max} [maximum precipitable water] values over land was investigated by analyzing future (2041-2070 and 2071-2100) and control (1971-2000) simulations from the Coupled-Model Intercomparison Project phase 5 (CMIP5) archive . . . The analysis reveals projected increases across all grid cells, indicating general global moistening of the atmosphere . . . The increases in PW_{max} are a robust result in the model simulations and have a strong theoretical basis, the Clausius-Clapeyron equation, linking the increases to increasing temperature. The PW_{max} increases are large and, if incorporated into PMP estimates, would have major implications for design of dams and other long-lived and critical runoff control structures.[104]

This projection is concerning, especially seeing that this region has already seen episodes of disproportional rainfall; in particular in June of 2012. Much of the St. Louis River and these parts of St. Louis County and Carlton County suffered unprecedented rainfall and catastrophic flooding, which wiped out whole towns, bridges, and roads. As a dam stands in perpetuity, such events must be a part of the evaluation and modeling in order to have a complete safety analysis. Jim Kuipers notes that facilities such as the FTB "are built during the development and operation of mines and remain as part of the landscape becoming a permanent feature that must perform as designed after the closure if the mine indefinitely."[105] Thus, the potential impacts of climate change and a generally warmer and more precipitous atmosphere need to be taken into consideration and such projections included in modeling when determining the strength and stability of the dam.

Such precipitous events also beg the question of adequate drainage. This issue has been raised by the United Nations Environment Programme, particularly in regard to areas with more saturated soils:

> The filter under-drainage system is a critical facility that has often been overlooked in the past, resulting in dangerously high phreatic surfaces within the body of the tailings dam. As is well known, the outer slopes of a tailings dam are very sensitive to the level of the phreatic surface. Capillary rise above the measured position of the phreatic surface can make the tailings in this zone to be close to full saturation. This condition can produce unexpectedly large rises of the phreatic surface from remarkably small amounts of rainfall.[106]

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[104] Exhibit 18 at 1404 (emphasis added).
[105] Kuipers Dam Safety Permit Comments at 2 (Exhibit 2).
[106] Tailings Dams Risk of Dangerous Occurrences: Lessons Learnt from Practical Experiences, Bulletin 121, U.N. ENVT'L PROGRAMME, 17 (2001), http://www.unep.fr/shared/publications/pdf/2891-TailingsDams.pdf., attached as Exhibit 19.

The concern that historical precipitation patterns may paint a misleading picture of the risk to tailings dams was also poignantly highlighted by DNR's consultant, Spectrum Engineering. Don Sutton wrote to DNR's Dam Safety Engineers that:

> The climate is changing in unpredictable ways that makes it difficult to predict the water balance. For example, at the Zortman and Landusky sites in north central Montana, we have experienced three plus 100 year events in the last 10 years. In 2011, we experienced an event believed to be the 200 or 500 year event that overwhelmed all our water management and water treatment facilities and caused a waste dump to collapse and destroy a water capture and pump back station. The average precipitation for the last 2 years is 100% above average.[107]

We have already seen dramatic changes in precipitation in Minnesota as a result of climate change. Over the last 50 years, the amount of precipitation falling in heavy events has increased 37%, more than any other region in the U.S. except New England.[108] Compare to 1961-1970, the decade from 2001-2010 saw a 71% increase in severe storms of 3 inches or more, one of the largest increases in storm frequency in the country (note that PolyMet's reference data for precipitation is from 1978).[109] This "tendency towards precipitation extremes," along with higher average annual precipitation overall, is projected to continue unabated into the future.[110]

Even assuming that the levels of precipitation do fall within these parameters, the Dam Break Analysis does not address the issue of discharge back into the watershed. This lack of downstream impacts is discussed further below.

1.5.2 Inflow Design Flood

> The Inflow Design Flood (IDF) is the most severe inflow flood for which a [tailings storage facility] TSF or associated facilities are designed and should be considered applicable to the construction, operation, and transition phases. In selecting an IDF the risks of hydrologic failure of a TSF should be balanced with the potential downstream consequences.[111]

This is the approach recommended by the Federal Emergency Management Agency; importantly, "FEMA notes that no single approach to selection of an IDF is adequate given the unique situations of each site," and recommends four approaches to an IDF analysis.[112] These four approaches are the Prescriptive Approach, Site-Specific PMP Studies (Refinement of the Prescriptive Approach),

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[107] Exhibit 11.
[108] Minnesota Dep't of Health, Minnesota Climate and Health Profile Report 2015, at 20, attached as Exhibit 20.
[109] *Id.* at 21.
[110] *Id.* at 32.
[111] Kuipers Dam Safety Permit Comments at 10 (referencing recommendations by the Canadian Dam Association) (Exhibit 2).
[112] *Id.* at 10.

Incremental Consequence Analysis, and Risk-Informed Decision Making.[113] The descriptions as given by Mr. Kuipers are as follows:

> Prescriptive Approach – In this initial phase, a planned dam is designed or an existing dam is evaluated for a prescribed standard based on the hazard potential classification of the dam. This approach is intended to be conservative to allow for efficiency of resource utilization while providing reasonable assurance of the safety of the public. It is not intended to assure that there is an economical marginal benefit from designing for a conservative IDF.
>
> Site-specific PMP Studies (Refinement of the Prescriptive Approach) – The prescriptive approach relies upon determination of a PMF for high hazard dams which requires assessment of the PMP. The most common sources of the PMP information are the regional HMRs published by the NWS. These reports provide generalized rainfall values that are not basin-specific and tend to represent the largest PMP values across broad regions. Most of these reports have not been updated to reflect current state-of-the-art knowledge and technology. A site-specific study of the PMP/PMF using current techniques can result in a more appropriate estimate of the PMF for consideration as the IDF.
>
> Incremental Consequence Analysis – The volume of many reservoirs may be small in comparison to the volume of the hydrologic events to which they may be subjected. In these cases, the IDF can be established by identifying the flood for which the downstream consequences with and without failure are not significantly different.
>
> Risk-informed Decision Making – This method allows a dam owner or regulator to consider the risk associated with hydrologic performance of dams relative to other dam safety risks at the same dam, across a portfolio of dams, or in comparison to societal risks in general. In this method, the IDF is selected as the design flood which assures that a given level of "tolerable risk" is not exceeded. The strengths of this method include providing dam owners and regulators the ability to assess the marginal value of increasing levels of flood protection, balancing capital investment in risk reduction across a number of different failure modes, and prioritizing risk reduction actions across a portfolio of dams.[114]

As can be seen by the outline of this program, the analysis conducted for the NorthMet TSFs are inadequate and do not use the most recent, most accurate information available (see "PMP and PMF analysis" subsection above). These types of anticipatory analyses are inherently limited as they are calculations conducted with limited empirical records, and only provide an estimate.[115] Therefore, the most recent, accurate records must be provided, and multiple assessments using different approaches must be conducted.

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113 *Id.*
114 Kuipers Dam Safety Permit Comments at 10 (emphasis added) (Exhibit 2).
115 *Id.* at 10-11.

1.5.3 Hypothetical Dam Failure Scenarios

The other issue present in this analysis is the fact that only one scenario was selected as the cause of the dam break for the study. "Piping" was selected in this analysis, and is explained as follows:

> Piping is the process whereby seepage through the dam is of sufficient velocity to initiate erosion and downstream transport of soils from the structure of the dam. Failure resulting from overtopping the dam was not considered because the dam is designed to not be overtopped even with the volume of the 72-hour PMP event.[116]

As stated above, this analysis does not take into account any precipitation patterns in the area from any point in the last 40 years. It also does not address any other number of potential events that could initiate dam failure, such as liquefaction of soil, and the role that may play in a sudden collapse of a dam wall. By way of comparison, the Mount Polley panel identified "four classes of failure mechanisms [that] required consideration . . . [b]ased on the experience of the Panel with both water and tailings dams . . . ."[117] In addition to piping, the Panel assessed cracking, human intervention, overtopping, and foundation failure.[118] Based on the tragedy that occurred at Mount Polley, anything less than preparing for what they assessed is irresponsible.

1.5.4 Lack of downstream analysis:

The primary purpose behind conducting the Dam Break Analysis was to supplement the Emergency Action Plan – in other words, to address what would happen to the 34 properties within the path of potential flooding should the dam breach or fail entirely on the north side. Furthermore, the Dam Break Analysis does not mention how many structures exist on those properties or how many lives on those identified properties would be at risk in the case of a dam breach.[119] While it is important to have a plan in action for the residents of the area should the dam breach, this is not the only thing that the Dam Break Analysis should (or as mentioned earlier, is required) to address.

To address some of these shortcomings, Mr. Kuipers makes the following recommendation:

> For the dam break analysis to be truly conservative, current industry guidance and experience suggests additional consideration should be given to the analysis. The CDA (2013) recommends the evaluation address initial hydrologic conditions for the following:
>
> - Sunny day failure – A sudden failure that occur during normal operations such as may be caused by internal erosion, piping, earthquakes, mis-operation leading to overtopping, or another event.

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116 FTB Dam Break Analysis at 5.

117 *See* Mount Polley panel Report at 9 (Exhibit 6).

118 *Id.*

119 Kuipers Dam Safety Permit Comments at 21 (Exhibit 2).

- Flood induced failure – A TSF failure resulting from a natural flood of a magnitude that is greater than what the dam can safely pass.

The incremental environmental consequences are often worse for a sunny day failure than a flood induced failure because of the large amount of process water and solids that are contained by TSFs (CDA 2014). The CDA (2013) recommends that simple and conservative procedures be applied to obtain a first approximation and that if necessary more detailed analysis should be conducted.[120]

Minnesota statutes require that public health and safety, in addition to the welfare of the public and the environment, need to be considered when a permit is issued.[121] This Dam Break Analysis does not take into account the potential hazards to the environment and surrounding waterways and water bodies should the dam fail. There is no analysis as to how to stop the flooding or escape of hazardous material should it find its way into a tributary of the St. Louis River, and flow downstream. Moreover, only one side of the dam was analyzed for the Dam Break Analysis – the side that faces the structures – which happens to be the north end of the dam.[122] The other sides, or the potential waterways or natural features they could affect, were not analyzed. DNR's staff has previously expressed concern that an eastern breach could reach Colby Lake through Wyman Creek, and PolyMet's only response was to flatly state that "a breach to the east would not reach Colby Lake."[123] Unsubstantiated denial, however, cannot constitute the "substantial evidence" required by law.

PolyMet conceded that other specific analyses (including but not limited to "evaluat[ion] [of] flotation tailings deposition after the breach" or "flow properties of the liquefied flotation tailings") were not included.[124] PolyMet claims that "[s]uch analysis is not warranted given the objective of this dam break analysis, which is to serve as an aid in development of the facility Emergency Action Plan."[125] Exclusion of a downstream analysis and the impacts on the surrounding waterways is contrary to the regulatory requirements and as such is inadequate.

1.6 PolyMet should incorporate a Failure Modes Effects Analysis (FMEA).

A FMEA "assist[s] in the TSF design and identification of other key aspects such as operational and closure requirements to ensure TSF safety."[126] The utilization of such analyses has become widespread, and is now considered a typical form of risk management. [127] According to experts in this field,

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120 *Id.*
121 Minn. Stat. § 103G.315, subd. 3.
122 See FTB Dam Break Analysis, supra note 95; see also Kuipers Dam Safety Permit Comments at 21 (Exhibit 2).
123 DNR Dam Safety Review Comments on NorthMet Project Flotation Tailings Basin Management Plan v. 2, Dec. 2012, attached as Exhibit 21.
124 FTB Dam Break Analysis at 7.
125 *Id.*
126 *Id.* at 19.
127 *Id.*

an effective risk management program must include the following elements:

- Identification of all failure modes and the factors that contribute to the likelihood of occurrence of that failure mode.
- A realistic assessment of the probability and consequences – yielding a risk rating.
- A program that mitigates the risks to reduce either probability (likelihood) or consequences to tolerable levels.
- An Action Plan and Management that implements the Action Plan.[128]

The design engineer for the PolyMet project did not conduct one of these, and it is recommended that one should be conducted, followed by a risk mitigation assessment and periodic MFEA reassessments.[129]

1.7 An accurate Probabilistic Seismic Hazard Analysis requires full dynamic modeling accounting for the Maximum Credible Earthquake and increased target factors of safety for slope stability in construction, operation, and transition phases in the seismic assessment.

The permit application as it stands presents two major issues with how the FTB has been proposed by PolyMet. The first is the seismic design event. The Probabilistic Seismic Hazard Analysis (PSHA) anticipates that a 2,475-year return seismic event is the largest seismic event that the dam potentially will experience. As laid out in Geotechnical Data Package Volume 1 (Section 6.5.3.3), the seismic liquefaction screening evaluation states that "the seismic design event . . . would not trigger liquefaction in any FTB materials . . . [so] no additional seismic triggering analyses were necessary."[130] Dr. Chambers notes that the use of the 2,475-year event renders a less accurate assessment of potential seismic activity, and that the PSHA should have used the Maximum Credible Earthquake (MCE) as the design earthquake.[131] It does not reflect the accepted current best practice.[132] With the MCE, there is a 10,000-year recurrence interval.[133] Dr. Chambers notes that this kind of an event has the potential to occur anywhere, and that its inclusion in such an analysis is vital for two reasons: (1) a structure like a tailings dam must stand in perpetuity, and thus must be designed to withstand something like the MCE, and (2) there are many active faults that have never

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128 *Id.*
129 *Id.* at 19-20.
130 NorthMet Project, Geotechnical Data Package Vol. 1 – Flotation Tailings Basin, prepared for PolyMet Mining, Inc., BARR ENG'G. Ver. 7, Sec. 6.5.3.3 (July 11, 2016). [hereinafter "GDP Vol. 1 - FTB"].
131 Dr. David Chambers, "Comments on NorthMet Mining Project and Land Exchange Supplemental Draft Environmental Impact Statement, prepared by Minnesota Department of Natural Resources, United States Army Corps of Engineers, United States Forest Service, November, 2013", CTR. FOR SCIENCE IN PUB. PARTICIPATION, 15 (Mar. 14. 2014) [hereinafter "Dr. Chambers SDEIS Comments"], attached as Exhibit 22.
132 Kuipers Dam Safety Permit Comments at 22(Exhibit 2).
133 David Chambers SDEIS Comments at 15 (Exhibit 22).

been mapped, or active faults previously thought to be inactive, so the potential for an active fault to be near the dam site is higher than PolyMet's assessment accounts for.[134]

In addition, a full dynamic model needs to be conducted in order to truly anticipate the potential weaknesses in not only the actual dam structure itself, but the geologic layers on the proposed building site. According to Dr. Chambers, "PolyMet performed what might be termed a pseudostatic analysis."[135] For projects with such stature as the FTB Dam, a pseudostatic analysis is considered deficient and currently is not accepted by most U.S. regulatory agencies, including the Federal Energy Management Agency; an agency regularly analyzing dam safety and seismic stability.[136] In order to fully anticipate and mitigate the potential for a seismic event, full dynamic modeling needs to be conducted, and the resulting information incorporated into the final decision in whether or not to grant the permit.

Mr. Kuipers takes this into account in his comments; he references recommendations from the Canadian Dam Association (CDA), which suggests that "crest deformations could be much larger [on tailings storage facilities as] compared to conventional dams,"[137] and as such "'criteria should be established for suitable deformations of a mining dam and the appropriate analyses undertaken to demonstrate the effect of an earthquake on the dam and determine if the deformation criteria is met.'"[138] Mr. Kuipers also points out that other states, including Montana and New Mexico, and British Columbia in Canada require use of the MCE and higher target factors of safety as well.[139] He includes the following statement from CDA:

> A factor of safety of 1.3 may be acceptable during construction of a dam where the consequences could be minor and measures are taken during construction to manage the risk such as detailed inspection, instrumentation, etc. But, the factor of safety of 1.3 should not simply be adopted because it is "End of construction." A factor safety of 1.5 has typically been adopted for tailings dams because of the potential consequences of failure. Therefore, when setting the design criteria for the dam, these target levels can be considered, but the risks associated with instability of the dam also need to be considered.[140]

The CDA also provides a table which contains the loading conditions and the minimum factors of safety – this table shows that a pseudostatic loading condition (like the one PolyMet has employed in the PSHA) shows a minimum factor of safety of 1.0.[141] This is below the values recommended by the CDA.

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134 *Id.*
135 *Id.*
136 Dr. Chambers SDEIS Comments at 16 (Exhibit 22).
137 Kuipers Dam Safety Permit Comments at 6 (Exhibit 2).
138 *Id.* (quoting Canadian Dam Association).
139 *Id.* at 6-9.
140 *Id.* at 7 (quoting Canadian Dam Association).
141 *Id.* at 7, Tbl. 5 (quoting Canadian Dam Association).

1.8 The Barriers Proposed to Mitigate Harmful Seepage from the Tailings Facilities Are Inadequate and Unlikely to Prevent Contamination of Surrounding Ground and Surfacewaters

As detailed in the attached comments of Dr. Malusis (Exhibit 5), while the testing of bentonite amendment is a laudable goal, the draft permits and permit application materials contain only the barest conceptual information as to how this testing will be done. But the efficacy of the bentonite amendment is not some peripheral component of the mine design; it is a critical determinant of whether the mine complies with the law or not. The effectiveness of the bentonite affects whether the mine complies with Minn. R. 6132.2200, subp. 2(B)(2) and it also substantially influences the stability of the FTB dam. The bentonite testing, in other words, goes to the heart of the matter, and by issuing the permit as drafted, the Department would be permitting a mine with only the barest of details to decide whether the mine and its dams pose a risk to the public health, safety and welfare. As drafted, the permits do not contain sufficient information for the Department to comply with the 'substantial evidence' requirements of the dam safety regulations.

Dr. Malusis addresses this concern in detail, and we will not duplicate that effort here, but incorporate his comments by reference. We will note here, however, that Dr. Malusis is not alone in his concerns. DNR consultants themselves characterized the proposal to cover the tailings with bentonite to prevent infiltration of oxygen as a "hail mary."[142] Those consultants concluded that the bentonite seal "will exacerbate erosion and slope failure and will eventually fail."[143] This is in fact the majority opinion – the literature on mine design is clear that "[c]overs have been found to present the risk of long term cracking or erosion, and to be ineffective in excluding air, so are less favoured solutions than submergence from the geochemical standpoint."[144]

Adding to Dr. Malusis' concern is the fact that DNR's Dam Safety staff expressed a belief that the percolation rate of 6.5 inches per year was almost certainly too low. When staff commented that this number "appears to be very low for the bentonite-amended FTB pond bottom (especially given the uncertainties associated with accurate bentonite placement)," PolyMet's only response was that the infiltration rate had already been accepted by the Department.[145] This response is troubling, for it avoids the central question and does not answer the concern that the infiltration rate is most likely understated. It may be irrelevant that the DNR had already accepted 6.5 inches as the infiltration rate, as the concern may not have been raised at the time acceptance occurred. Even more troublingly, it was not only DNR's staff that suggested the infiltration was understated. The issue was also raised by EOR, DNR's technical consultants, who wrote that 6.5 inches/year "appears to be very low (especially given the uncertainties associated with this methodology)."[146]

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142 Memorandum from Spectrum Engineering to Jennifer Engstrom, Feb. 24, 2012, attached as Exhibit 23.
143 *Id.*
144 Exhibit 7.
145 DNR Dam Safety Review Comments for the NorthMet Project Flotation Tailings Basin Management Plan v. 2, Dec. 2012 (Exhibit 21).
146 See email from Michael Kunz to Michael Liljegren with attached comments from EOR, Oct. 15, 2012, attached as Exhibit 24.

Indeed, given the verbatim language, it appears as though this concern originated with DNR's consultants and was conveyed to PolyMet through DNR staff. For DNR to ignore this concern on the basis that the infiltration rate had been accepted prior to its consultants raising any questions about it, would clearly violate the substantial evidence requirement. This is an issue that goes to the heart of the regulations – DNR is without a basis to determine that this proposal will prevent the movement of substantially all water through mine waster as required by Minn. R 6132.2200 if the assumptions about the rate in which water moves through the tailings pile are significantly understated, as DNR's own consultants have indicated.

1.10 <u>The utilization of the LTV Steel Mining Company (LTVSMC) tailings basin adds to the overall risks of the FTB – the basin was constructed before environmental review laws came into effect, and was built to hold a completely different set of substances.</u>

The reclaimed LTV Steel holding pond that PolyMet is now proposing to turn into the FTB was constructed prior to the enactment of environmental review laws and requirements. In addition to the lack of environmental review, there is an inherent risk present in repurposing something for use for which it was not designed. The original LTVSMC dam was built for a different purpose; it was built to hold different volumes of different materials that interact in different ways with the natural environment and organic compounds. The FTB was not designed for what it is being repurposed for. Throughout the EIS process, it was touted as a more affordable and even efficient alternative because the site would be repurposed –there would be no new disturbance, per se, of the surrounding environment by having to clear land and construct a new tailings basin. The LTVSMC dam has experienced reclamation of sorts, but it still possesses taconite tailings and other waste from LTV Steel's former days.[147] The Mount Polley panel suggests that the BAT approach for both new mines and existing mines is to construct a new tailings basin specifically for the material being mined.[148] Using it as a tailings basin for mining waste that has potentially catastrophic implications for both the natural environment and public health does not meet the requisite burden laid out under state regulations.[149]

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147 See, e.g. FTB Draft Permit at Attachment H.
148 Mount Polley Panel Report at 125 (Exhibit 6).
149 See Minn. Stat. § 103G.315, subd. 3 (requiring that the Commissioner shall grant the permit "[i]f the commissioner concludes that the plans of the applicant are reasonable, practical, and will adequately protect public safety and promote the public welfare . . ."); Minn. R. 6115.0300 (stating that the intent of the regulations is to regulate the construction, operation, maintenance, and transfer of ownership of any dam "in such a manner as to best provide for public health, safety, and welfare."); Minn. R. 6115.0410, subp. 8(D) ("Approval or denial [of the permit] shall be based on the potential hazards to the health, safety, and welfare of the public and the environment including probable future development of the area downstream or upstream. The applicant may be required to take measures to reduce risks, and the commissioner shall furnish information and recommendations to local governments for present and future land use controls to minimize risks to downstream areas. The commissioner shall determine if the proposal is adequate with respect to: The stability of the dam, foundation, abutments, and impoundment under all conditions of construction and operation, including consideration of liquefaction, shear, or seepage failure, overturning, sliding, overstressing and excessive deformation, under all loading conditions including earthquake. This determination must be

1.11 The parallels between the proposed flotation tailings basin and the tailings storage facility at Mount Polley need to be drawn and assessed – there is more at issue than just the slope of the embankments.

The Mount Polley Expert Panel assessed the use of the upstream dam model after the Mount Polley Dam collapse in August of 2014; they came to the conclusion that this model is inherently dangerous and as such should not be used in any new dams.[150] The little credence given to this opinion is addressed by PolyMet as being a very different project, despite overall similarity because of the angle of the proposed slope being more gradual and thus safer for the overall structure. Given the extensive damage resulting from the dam failure at Mount Polley, and the overall similarities described in further detail below, the report conducted by the Panel needs to be given more credence in the assessment of the dam safety permits for which PolyMet has applied. In light of the Mount Polley disaster, only one such catastrophic disaster that has occurred, the opinions of the experts reviewing the breach and its causation must be given ample weight. A conservative approach must be taken in each assessment of the dam safety permits when reviewing the permit and application materials.

One of the first things that the panel of experts note is that upstream dam construction is the least safe way to construct a dam surrounding a tailings basin.[151] This design is often chosen simply because it is the least expensive way to construct and operate a basin of such large stature.[152] The Panel urged in its findings on the breach that cost of construction should not be the determining factor.[153] Environmental destruction and public health risks aside, the remediation costs would almost certainly surpass any initial costs spent on preventative measures, including but not limited to a safer dam design. The Panel urges a BAT analysis in order to ensure security and stability in the dam once the mine begins operating.[154]

PolyMet claims that this FTB dam is much safer than the one that was constructed at Mount Polley mostly because Mount Polley is a mountainous region and the slope was much steeper than the one that is proposed for the FTB at the NorthMet site.[155] There is more at issue than just the slope of the embankments. As stated above, Dr. Chambers notes that the mere design of the dam, notwithstanding slope, is inherently unstable and unsafe.[156] Roughly half of the tailings storage facilities around the world are built in the upstream design, "however upstream dams are more

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based on current, prudent engineering practice, and the degree of conservatism employed must depend on hazards.").

150 Mount Polley Panel Report at 118-133 (Exhibit 6).

151 Chambers Draft Dam Safety Permit Comments at 1 (Exhibit 3).

152 Mount Polley Panel Report at 125 (Exhibit 6).

153 *Id.*

154 *Id.*

155 "Tailings Basin Stability and Environmental Protections", POLYMET MINING, INC. (May 1, 2015), http://polymetmining.com/wp-content/uploads/2015/05/Fact-Sheet-Tailings-Apr-2015-_2_.pdf.

156 Chambers Draft Dam Safety Permit Comments at 1 (Exhibit 3).

susceptible to liquefaction flow events and are solely responsible for all major static liquefaction events."[157] Certainly slope has a role to play in the overall equation of safety and stability, but the prevailing factor is the design itself; all subsequent factors stem from the design.

The primary issue with the slope at Mount Polley was the fact that during construction, the necessary materials to extend the slope outward (making it a more gradual rise) ran out.[158] Thus, a steeper sloped wall was constructed; the intention was for the wall to be temporary, and flattened out at a later date.[159] The mine began operation on time with the wall constructed, the result being a less sturdy wall, and monitoring and construction would be ongoing.[160] The Mount Polley disaster highlights the dangers of ongoing construction and testing that should have been completed in the pre-permit stages, before the mine began operating.

Jim Kuipers notes that when the Expert Panel was formed, they issued a set of recommendations that can be grouped in seven categories:

1. Implement Best Available Practices (BAP) and Best Available Technologies (BAT) using a phased approach,
2. Improve corporate governance,
3. Expand corporate design commitments,
4. Enhance validation of safety and regulation of all phases of a TSF,
5. Strengthen current regulatory operations,
6. Improve professional practice, and
7. Improve dam safety guidelines[161]

He describes the Panel's set of recommendations in each of these categories, and how other groups have responded to them (namely, the British Columbia regulatory revisions, and Montana's Metal Mine Reclamation Act (MMRA), and then how Minnesota's regulations stand in comparison.[162] In almost each circumstance, each of the other jurisdictions adopted many or most of the Panel's recommendations. Minnesota, however, did not adopt these provisions or adopted only part of the recommendations. This is problematic when assessing the safety and stability of a very similar project. This circles back to the importance of implementing very conservative designs, and using conservative data when making calculations or conducting modeling.

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157 Michael Davies et al., Mine Tailings Dams: When Things go Wrong, ASSOC. OF STATE DAM SAFETY OFFICIALS, U.S. COMMITTEE ON LARGE DAMS, 10 (2002), http://www.infomine.com/library/publications/docs/davies2002d.pdf, attached as Exhibit 25.
158 Mount Polley Panel Report at 61 (Exhibit 6).
159 *Id.*
160 *Id.*
161 Kuipers Dam Safety Permit Comments at 12 (Exhibit 2) (referencing the Mount Polley Panel Report).
162 *Id.* at 12-13.

1.12 The integrity of the liner system at the Hydrometallurgical Residue Facility (HRF) is something that has not been adequately addressed at previous junctures – the problematic material, namely old tailings, should be removed down to the bedrock in order to ensure stability.

Throughout the EIS process, comments on the liner of the HRF were continually ignored. Thus, the design for the liner of the HRF has not changed much since these early stages. Of primary concern are the old taconite tailings from LTVSMC, which PolyMet has proposed consolidate with sediments in order to stabilize the material prior to the construction of the dam at the HRF.[163] Dr. Chambers notes that this is an unwise way to approach dam stabilization.

First, he says that the previous tailings can be removed, and placed in the FTB.[164] The other sedimentary layers should also be removed down to the bedrock, which should serve as the foundation for the HRF.[165] If PolyMet were to take this approach, "not only would the subgrade be more stable, nut more room for hydrometallurgical residue would be gained. In the case of the Hydrometallurgical Residue Facility placing the liner on the granite bedrock is possible."[166]

Second, Dr. Chambers states that "safety, not cost" should be the driver in weighing different options for dam liner designs.[167] If bottom liners fail or need to be repaired at any point in time, they almost certainly cannot be fixed without emptying out the basin, which leads to trouble when dealing with mining waste.[168] In other words, it is far more cost effective and safe to ensure safety and stability on the front end.

Furthermore, Dr. Chambers notes that "[a]dequate factors of safety should be guaranteed by installing engineered facilities verified by quality control, when possible – not by modeling."[169] This can be more readily ensured by removing layers down to the bedrock.[170]

1.13 The analyses conducted by Barr Engineering for PolyMet regarding the Hydrometallurgical Residue Facility are inadequate; a full dynamic model needs to be conducted.

1.13.1 Probabilistic Seismic Hazard Analysis is Insufficient

Similar to the Flotation Tailings Basin, PolyMet employed a smaller (and less severe) Probabilistic Seismic Hazard Analysis than some experts recommend. PolyMet employed a 2,475-

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163 Residue Management Plan, NorthMet Dam Safety Permit Application: Hydrometallurgical Residue Facility, 10 (May 15, 2017) [hereinafter "HRF Permit Application"].
164 Chambers FEIS Comments at 23 (Exhibit 15).
165 *Id.*
166 *Id.*
167 *Id.*
168 *Id.*
169 *Id.*
170 *Id.*

year return event, as opposed to the Maximum Credible Earthquake (MCE).[171] Dr. Chambers notes that the MCE "should be used for the design event for all permanent structures, both dams and waste rock. The Maximum Credible Earthquake is recommended to be a 10,000-year return period earthquake."[172] Similar to the FTB, the use of a 2,475-year return severely underestimates the potential effect that a significant seismic event could have on a structure like a dam, a tailings basin, or on waste rock itself.

PolyMet notes that "Northern Minnesota is not a highly active seismic zone."[173] The manner in which the risk for future events was calculated was based almost entirely on small, past events – namely the 20 small-to-moderate earthquakes that Minnesota has experienced and recorded[174] - and placed in a seismic risk calculator provided by the United States Geological Survey.[175] This information does not account for the risk of geologic layers moving and changing (see Mount Polley disaster), undiscovered or unrecorded fault lines, or previous fault lines once thought dormant, that have become active or may become active in the future. These are all aspects that engineers need to take into account in order to ensure stability, as dams are built to stand in perpetuity, and can be done so with a 10,000-year seismic event calculation.[176]

The results from PolyMet's own calculations – from the FEIS to the Geotechnical Data Package (Volume 2) – demonstrate the intensity of the acceleration as it increases from a smaller event to a potentially catastrophic event. The FEIS contains the information in Table 6-2: Summary of PSHA Results.[177] For example, a 975-year return event has a maximum acceleration of 0.025g, whereas a 2,475-year return event has a maximum acceleration of 0.055g.[178] This is over twice the size of the 975-year return event, and Dr. Chambers comments that this falls woefully short of demonstrating how a 10,000 year-return event could affect the dam or waste rock; the acceleration for such an event would be "significantly larger",[179] meaning that the impact of the event and subsequent damage would be as well.

Lastly, and arguably most importantly, Dr. Chambers stated the following in his comments: "Even if the legal requirement is only for a 2,745-year return design earthquake, from an engineering standpoint and safety standpoint PolyMet and its consultants should not accept the minimum required. They should do what safety and conservative management requires."[180]

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171 *Id.* at 25.
172 *Id.* at 23.
173 NorthMet Project Geotechnical Data Package, Vol. 2 – Hydrometallurgical Residue Facility, 13 (July 11, 2016) [hereinafter "GDP Vol. 2 - HRF"].
174 *Id.* Minnesota has recorded 20 small-to-moderate earthquakes since 1860.
175 *Id.*
176 Chambers SDEIS Comments at 15 (Exhibit 22); see also Chambers FEIS Comments, supra note 70 at 23 (Exhibit 15).
177 Chambers FEIS Comments at 25 (Exhibit 15).
178 *Id.*
179 *Id.*
180 *Id.*

1.13.2 Dam Break Analysis for the HRF is Inadequate

PolyMet has not shown that the dam as currently proposed is "reasonable, practical, and will adequately protect public safety and promote the public welfare. . ."[181] Simply put, PolyMet has not adequately addressed the possibility of dam failure and what mitigation factors will be implemented should such an event occur. PolyMet, as the dam applicant, has the burden of proving that such a structure is reasonable and practical,[182] and must show that the application itself is based on substantial evidence.[183] The "dam break analysis" that was conducted revealed no plausible scenarios for dam failure were identified.[184] In the Technical Memorandum, PolyMet supplied a few hypotheticals (which were labeled as hypotheticals in the memorandum), as the basis for their conclusion in that further analysis was not necessary. The three-and-a-half page memorandum concluded that the HRF dam failure hypotheticals all have a "low probability" of occurrence, despite being possible, and thus, "[a]dditional hydrologic and hydraulic modeling to detail the extent of inundation from an HRF Dam break is not warranted because no plausible HRF dam failure scenarios have been identified."[185] At no point was a full dynamic model said to have been conducted.[186]

Dr. Chambers identifies this as troublesome, and furthermore inadequate. He states that full dynamic modeling needs to be conducted in order to fully assess and appreciate the potential for a dam breach.[187] By intentionally not conducting a full dynamic modeling analysis and instead listing out a few hypotheticals in the dam break analysis, PolyMet has not met their burden, and a dam safety permit for the HRF should not be issued unless and until it has.

1.13.3 Liquefaction Analysis Has Not Been Completed

Dr. Chambers states that despite the fact that the HRF is proposed to be constructed in the downstream fashion, as opposed to the more fallible upstream design, the prosed construction material, as it stands in the application, is insufficient for stability and requires a more conservative approach in analysis and testing in order to ensure dam stability and safety. Liquefaction analyses were not conducted at either the SDEIS stage or the permit application stage. At each juncture,

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181 Minn. Stat. 103G.315, subd. 3, 6.
182 Minn. Stat. 103G.315, subd. 6.
183 Minn. Stat. 103G.315, subd. 2.
184 HRF Permit Application at 8.
185 HRF Dam Break Analysis, Hydrometallurgical Residue Facility, NorthMet Dam Safety Permit Application, prepared for PolyMet Mining, Inc., BARR ENG'G, Attachment L (May 2017).
186 *Id.*
187 David Chambers, "Comments on the Geotechnical Stability of the Proposed NorthMet Tailings Basin and Hydrometallurgical Residue Facility in light of the Failure of the Mt Polley Tailings Storage Facility", CTR. FOR SCIENCE IN PUB. PARTICIPATION, 4 (Apr. 30, 2015), attached as Exhibit 26.

PolyMet and its engineers stated that it was not applicable and thus was not performed.[188] Despite the changes from the SDEIS stage to the permit application stage, which designate more compact layers for the base of the dam, a liquefaction analysis is still necessary, and is required for the Commissioner's consideration and subsequent approval of any dam safety permit.[189] Furthermore, the updated layers of the base of the dam still include leftover tailings from the LTVSMC era; experts like Dr. Chambers have argued against the inclusion of these layers from the EIS stage of the process because of the lack of stability.[190] This is particularly troublesome because the dewatering calculations conducted on the Drainage Collection System in the HRF do not consider the potential for drainage through the taconite layers.[191] PolyMet concedes that "drawdown may be more rapid than modelled" for the maximum residue depth.[192] The estimated time for drainage to occur is 14 years, or 5,113 days.[193] A more rapid drawdown is surely going to have a heavier impact than calculated given the anticipated 20-year life of the mine.

The recommendation made by Dr. Chambers has been to remove the underlying original ground (still included in the permit application and updated Geotechnical Data Package Vol. 2),[194] peat and silty materials (even if they are "well-compacted"), and the taconite tailings waste, in order to ensure increased stability.[195] These materials should be removed down to the bedrock in order to ensure stability.[196] Ensured stability requires not only material replacement, but full dynamic modelling, including a liquefaction analysis for the HRF.

1.14 The need for independent review

Dr. Chambers and Mr. Kuipers both call for independent review of both the FTB and HRF dams in assessing the overall process. This is the recommendation of the Mount Polley Panel as well.[197] Dr. Chambers states that neither permit "require[s] an Independent Tailings Review Board."[198] Furthermore, Mr. Kuipers notes that "a truly independent review process must be undertaken that includes the participation of additional TSF expertise including nominees from public stakeholders."[199]

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188 NorthMet Mining Project and Land Exchange, Supplemental Draft Environmental Impact Statement, MINN. DEP'T OF NAT. RES., U.S. ARMY CORPS OF ENGRS., U.S. FOREST SERV., 5-575 (Nov. 2013); GDP Vol. 2 - HRF, at 47.
189 Minn. R. 6115.0410, subp. 8(D).
190 Chambers FEIS Comments at 23 (Exhibit 15).
191 GDP Vol. 2 - HRF at 47.
192 *Id.* at 50.
193 *Id.*
194 *Id.* at sec. 6.0.
195 Chambers FEIS Comments at 23 (Exhibit 15).
196 *Id.*
197 Mount Polley Panel Report at 129-130 (Exhibit 6).
198 Chambers Draft Dam Safety Permit Comments at 3-4 (Exhibit 3).
199 *Id.*

1.15 DNR Acknowledges that the FTB and HRF Dams Pose a Long-Term Threat to the Public Health, Safety and Welfare, Even if the Dams Are Effective for the 20-Year Life of the Mine

Over the last few years, the undersigned organizations have made no secret of our view that these proposed dams pose an unreasonable risk to the public. This view, however, is not simply a voice in the wilderness. DNR's own staff and consultants have for years raised alarms about the safety of these proposed dams. The Department has permit conditions available (Best Available Technology for tailings storage as recommended by the Mount Polley Expert Panel) that would alleviate these concerns, and yet it has failed to require alternative designs that would protect the public.

These concerns from DNR staff and consultants run the gamut, and should not be ignored. They include Edie Evarts, DNR's Area Fisheries Supervisor, who expressed her concern that the HRF facility posed a risk to fisheries:

> Fisheries' concern about the Hydrometallurgical Facility (HRF) is because it will hold waste from the metallurgical plant and will be dependent on a liner underneath and a wick drain system. This seems like it would function appropriately during operation of the mine and certainly our engineers and hydrologists have this covered for the review. My concern is about far into the future. How long does such a liner last and what happens when it inevitably degrades as nothing lasts forever? Even if it takes 200 years, the waste will still be there and in its location would be very susceptible to leaching into nearby wetlands and groundwater. [200]

Ms. Evarts' concerns for the long-term impacts of the proposed dams are well-founded, for the Department has been clear that it intends the dams to operate for a minimum of 1000 years.[201]

These concerns, in other words, go straight to the heart of the question of whether these dams as proposed are adequately protective of the public safety, health, and welfare. And those concerns have never been addressed. Despite the DNR's warnings that upstream construction is not a good method "for a dam that is required to last for centuries,"[202] that design element has never changed. Staff's warning was specific to the particularly vulnerable foundation of the proposed dam, clearly indicating what we have indicated here - constructing a slurry impoundment on top of fine tailings slimes is simply not safe:

> It is my understanding that the LTV tailings at depth are already in a semi-liquefied state. I remain concerned that if another 150 feet of tailings are added, and then

[200] Comments of Edie Evarts, DNR Fisheries Supervisor, Dam Safety Permits 2016-1383 and 2016-1380, attached as Exhibit 27.
[201] See, e.g., DNR Dam Safety Review Comments on NorthMet Project Flotation Tailings Basin Management Plan v. 2, Dec. 2012 (Exhibit 21) (referring to the "900 year design" of the FTB dam); Dana Dostert, Geotechnical/Geochemical Questions Related to PolyMet Tailings, January 31, 2012 (Exhibit 10).
[202] Email of Dana Dostert to Neil Schwanz, Oct. 1, 2010, attached as Exhibit 28.

> experience a major precipitation event such as last week's 14 inches in south central Minnesota, the loading will lead to liquefaction and an embankment failure. With EPA requiring cleanup of any spilled tailings, the cost to Polymet or the State of Minnesota would be in the tens of millions of dollars. Further complicating this issue is the use of upstream construction, which I don't think is a good method for a dam that is required to last for centuries.[203]

But the most serious concerns were raised by DNR's consultant from Spectrum Engineering, Don Sutton, discussed in more detail above. Spectrum, it should be noted, is a mine engineering firm with extensive experience in mine reclamation and remediation, and is therefore quite experienced in the regulation of mines at closure.[204] DNR obviously recognized this expertise when it retained Spectrum's services. In writing Dana Dostert, DNR's Senior Dam Safety Engineer, Mr. Sutton wrote that he shared Ms. Dostert's concerns with wet closure, but had additional concerns of his own "relating to the long term tailings wet closure uncertainties and risks."[205] Mr. Sutton believes that the bentonite amendment proposal is a 'hail mary,' and that if bentonite amendment doesn't work and perpetual water treatment is necessary, "why not investigate some dry closure options and compare the long term O&M costs and long term risks of each alternative?"[206] Although "PolyMet's reclamation plan could work for a while," he argued that he doesn't see "how it will function forever without falling apart unless it is continuously maintained; which is a major leap of faith."[207]

<u>2.0 If Permitted, the Commissioner Should Require Dry Stack Tailings as a Permit Condition Or, At a Minimum, Drained, Compacted Tailings at Closure</u>

As noted above, Minnesota law does not define the concept of "current, prudent engineering practice." But the law is clear that the state may not permit an impoundment of water for copper-nickel mining if an environmentally preferable alternative is feasible, prudent and reasonably available.[208] Such a permit may also be permitted only if the Department determines that the impoundment "will not substantially impair the interests of the public in lands or waters or the substantial beneficial public use of lands or waters except as expressly authorized in the permit and will not endanger public health or safety."[209] As we describe in Section 1.0 above, the environmental benefits of dry stack tailings are stark: the process eliminates the need for perpetual water treatment and it eliminates the risk of catastrophic tailings dam failures that would inundate local rivers, streams and residences with acidic mine waste. Not only is dry stacking therefore the best available technology for tailings storage, thus constituting the current, prudent engineering practice on which the dam safety must be based, it is also an environmentally preferable alternative that would render the draft permits unlawful under Minn. Stat. 116D.04, subd. 6 and 103G.297, subd. 3. As state law

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203 *Id.*
204 See Resume of Don Sutton, Spectrum Engineering, attached as Exhibit 29.
205 Email of Don Sutton to Dana Dostert (Exhibit 11).
206 *Id.*
207 *Id.*
208 Minn. Stat. § 103G.297, subd. 3; § 116D.04, subd. 6.
209 Minn. Stat. § 103G.297, subd. 3(2).

provides, "economic considerations alone shall not justify" the issuance of a permit that significantly affects the quality of the environment when there is a "feasible and prudent alternative."[210]

DNR's consultants were clear on this question: dry closures are the preferable alternative. Spectrum Engineering wrote to DNR's Dam Safety Engineers that:

> If seepage collection or treatment is or might be necessary for an indefinite time with a wet closure, then what is the benefit of wet closure? The wet closure is riskier, has more uncertainties, and may be more expensive because it will require more perpetual care and maintenance than a dry closure. I suggest that PolyMet investigate some alternatives . . . I don't like wet closure, because it is not a permanent closure. I believe it will eventually fail and release the sulfates.[211]

In an earlier email to DNR staff, Spectrum was unequivocal: wet closures are cheaper but riskier:

> PolyMet is proposing to build the tailings disposal system that has the lowest initial cost, but has more long term risks than other tailings disposal methods. There is risk associated with perching a lake full of saturated tailings on top of the existing tailings. It is difficult to quantify the probability of failure over a long time frame, but I think you can consider the consequences of failure and estimate the cost of cleaning up the failure, and then add the cost of operating the repaired facility forever. This cost can be compared to the additional cost of building a more stable facility initially.[212]

These conclusions of the technical consultants hired by DNR establish three critical things. They establish that wet closures of the kind proposed by PolyMet do not constitute the current, prudent environmental practice for mine design, which would prohibit the issuance of the permits as drafted.[213] They also establish that wet closures cannot be permitted unless the applicant has demonstrated that dry stacking is not feasible, prudent or reasonably available,[214] a demonstration that has not even been attempted, let alone made. And lastly, they establish that a known risk to the public health, safety and welfare may not be permitted solely because it is cheaper than mitigating that risk at the outset through safer tailings storage.[215]

Perhaps most importantly, all of these issues were expressly considered during the drafting of Minnesota's non-ferrous mining regulations, which effectively prohibit wet closures. Dry-stacking is therefore an alternative made reasonable by virtue of the fact that it is the only way that this mine can comply with Minnesota law. This rule states:

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210 Minn. Stat. § 116D.04, subd. 6.
211 Email of Don Sutton to Dana Dostert (Exhibit 11).
212 Email of Don Sutton to Jennifer Engstrom, June 15, 2011, attached as Exhibit 30.
213 Minn. R. 6115.0410, subp. 8(F).
214 Minn. Stat. § 103G.297, subd. 3; § 116D.04, subd. 6; Minn. R. 6115.0410, subp. 8.
215 Minn. Stat. § 103G.297, subd. 3; § 116D.04, subd. 6.

> B. A reactive mine waste storage facility must be designed by professional engineers registered in Minnesota proficient in the design, construction, operation, and reclamation of facilities for the storage of reactive mine waste, to either:
> (1) modify the physical or chemical characteristics of the mine waste, or store it in an environment, such that the waste is no longer reactive; or
> (2) during construction to the extent practicable, and at closure, permanently prevent substantially all water from moving through or over the mine waste and provide for the collection and disposal of any remaining residual waters that drain from the mine waste in compliance with federal and state standards.

Mine waste includes tailings. "Reactive mine waste" is defined as waste "that is shown through characterization studies to release substances that adversely impact natural resources." In other words, "reactive waste" is not limited to waste that creates acidic conditions. Heavy metals can leach from rock under many conditions, some of which do not involve a low pH; whenever those conditions result in a great enough release of metals to adversely affect natural resources, the rock is deemed "reactive." Thus the PolyMet tailings will be "reactive" even if they do not result in acid drainage, because they have been characterized (by PolyMet's modeling) to release (at a minimum) copper, nickel, lead, and arsenic at levels far above surface and/or groundwater quality standards.

Rule 6132.2200(2)(B) provides two possible means of handling reactive mine waste after closure. Either the waste rock, tailings, and exposed rock must be left in such a way that they are not "reactive" (i.e., they no longer leach heavy metals), or the facilities must be closed in a way that "permanently prevent[s] substantially all water from moving through or over" them. Taken together, the import of the regulations is that nonferrous mine waste and mine pits must be closed in a way that does not result in a significant amount of water that will have to be treated before it can be discharged to the environment.

The Statement of Need and Reasonableness for this rule makes it clear that the point of Rule 6132.2200(2)(B) was to preclude perpetual or long term water treatment as a closure option:

> [M]erely collecting contact water and treating it in order to meet water quality discharge standards, without a substantial effort to minimize the amount of water contacting the waste, has been rejected. While this method may provide acceptable results during active operations, when the permittee is present, the potential for long-term failure of such a system, when the operator is no longer available to correct the situation, is too great. Because of the necessity to provide a permanent solution to the water quality concerns related to reactive mine wastes, the two required methods of storing these wastes are the only reasonable methods currently available.[216]

The current plan for the tailings basin allows the tailings to remain reactive and allows a significant amount of water to move through the tailings. As noted above, the long-term infiltration rate is 6.5

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216 Rule 6132 Statement of Need and Reasonableness at 22, attached as Exhibit 31.

inches per year, or roughly 25% of annual precipitation (see section 1.8). And our consultants, DNR's consultants, and DNR's staff have all raised a concern that 6.5 inches per years seem very low, but this concern has never been addressed. It cannot be said that this mine proposal will prevent "substantially all" water from moving through the tailings if the company's own estimate, which the Department believes to be very low, is 25% of annual precipitation.[217]

The dam design thus does not meet the regulatory requirements. As Dr. Malusis concludes, "dry closure would be a much better approach for meeting the intent of Part 6132.2200 Subpart B(2)." This preference for dry closure is the same conclusion reached by Don Sutton, DNR's technical consultant from Spectrum Engineering, and Dana Dostert, the Senior Dam Safety Engineer for DNR (see section 1.15). The Department must accordingly require dry stacked and compacted tailings as the only suggested alternative that might meet the requirements of state law.

Dry stacking is also required by regulations directed specifically at Class I dams, such as the FTB dam in permit 2016-1380. Rule 6115.0410, subp. 8 requires the Commissioner to make a determination that the applicant has demonstrated "a lack of other suitable feasible and practical alternative sites, and economic hardship which would have a major adverse effect on population and socioeconomic base of the area affected." In other words, before dry stacked tailings may be lawfully rejected as an alternative to conventional slurry impoundments, the applicant must prove that dry stacking would impose such a severe economic hardship that it would adversely affect the area. No such showing has ever been attempted, and the Department is therefore prohibited by law from issuing the permits as drafted.

3.0 The Draft Permits Abdicate Critical Regulatory Responsibilities to a Later Date, Placing the Public's Safety and Welfare at Risk and Violating State Laws and Regulations

DNR's consultants addressed the issue identified by our consultants, namely, that building a new tailings facility directly on top of an older facility is not an engineering best practice. In its review, DNR's expert review team noted that the proposed dam will be built on top of the pre-existing tailings dam, which was constructed partially on top of peat layers. The existing dam itself was also built with layers of taconite slimes. Both the peat and the slimes have very low shear strength, "which could potentially contribute to a dam failure."[218] The review team concluded that the proposed dam could be designed to mitigate the risks of failure posed by the peat and slimes, but that to do so, the "areas with peat and slimes must be well-defined and tested . . . additional data should be gathered on the peat layers and slime layers."[219]

Presumably in response to these concerns, the draft permits state that construction may not commence until DNR has approved "additional strength and permeability testing of existing fine

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217 Michael Malusis, Comments on Draft Dam Safety Permits, attached as Exhibit 4; NorthMet Project Adaptive Water Management Plan, Barr Eng'g, v. 10, 92 (July 11, 2016).
218 Memorandum from EOR, PolyMet Dam Safety Permit Application Review, 3 (May 15, 2017).
219 *Id.*

tailings and bulk tailings in the tailings basin to confirm that the material properties used in the various seepage and stability models in the Flotation Tailings Basin Geotechnical data Package are still applicable."[220] In short, DNR's consultants have notified it that certain features of the dam proposed for permitting may "contribute to a dam failure," but the draft permit does not contain any conditions which might alleviate that risk. Instead, the permit simply kicks that can down the road, and says only that additional approvals of dam stability data are required before construction may begin.

But Minnesota law does not allow permit authorizations to be sequentialized in this way. The Rules require approval or denial of "final" designs.[221] That final design "shall include . . . analytical determinations, such as seepage and underseepage studies, stability, deformation and settlement analysis; analytical and design details of facilities, such as dam, foundation, impoundment, [or] abutments."[222] The rules do allow for alterations of the approved designs, but they do not contemplate the sort of piecemeal permitting approach that the Department has taken here. There is a great deal of difference between approving final designs and modifying them if it becomes necessary, and approving only the mere concept of a tailings dam and allowing critical components of its design to be approved at a later date. Not only does this approach circumvent the permitting regulations, it effectively insulates key aspects of the project from public review and comment, in violation of open governance laws.[223]

The project designs for which the Department's approval is deferred to a later time are not trivial or incidental aspects of the project. They are in fact the essence of the proposal, and the primary determinants in whether the project is done responsibly or whether it results in an environmental and financial burden on future generations. DNR's consultants concluded that the foundation of the buttress, for instance, must be investigated further to determine whether it is a suitable and stable foundation for the tailings dam.[224] But this buttress design is not approved by the draft permits. DNR's consultants also described the bentonite amendment plan as a "hail mary," but the bentonite amendment testing is not approved by the draft permits. They have also concluded that the existence of taconite slimes in the pre-existing tailings dam could pose a risk of dam failure, but rather than address that concern the draft permits require only that further materials testing be done.[225] The results of those tests, and the implications that they might have for future dam stability, will not be available for public comment. The list does not end there. The draft permits also defer

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220 Draft Dam Safety Permit No. 2016-1380, Permit Condition No. 29.
221 Minn. R. 6115.0410, subp. 6.
222 Minn. R. 6115.0410, subp. 6.
223 See, e.g. Minn. Stat. § 14.001 ("The purposes of the Administrative Procedure Act are: (1) to provide oversight of powers and duties delegated to administrative agencies; (2) to increase public accountability of administrative agencies; (3) to ensure a uniform minimum procedure; (4) to increase public access to governmental information; (5) to increase public participation in the formulation of administrative rules; (6) to increase the fairness of agencies in their conduct of contested case proceedings; and (7) to simplify the process of judicial review of agency action as well as increase its ease and availability.").
224 Technical Review Team Comments on PolyMet Dam Safety Permit Application Review, May 15, 2017, at 4.
225 *Id.* at 3.

approval of the water management plan, the contingency action plan, and the operation and maintenance plan.[226]

The deferred approvals, therefore, are absolutely essential components of the project's design, and critical determinants of the project's impact on the environment and public safety. When the Mount Polley disaster occurred, the investigation concluded that the "dominant contribution to the failure resides in the design."[227] And yet, despite this clear lesson from past mine failures, the draft permits for the tailings basin and HRF dams do not contain any conditions whatsoever concerning the buttress design, water management, materials strength testing, bentonite testing, contingency action plan, or the operations and maintenance plan. To be clear: the Mount Polley panel found that foundation investigations failed to identify a particularly vulnerable layer that was susceptible to undrained failure. Here, DNR's consultants have identified similar concerns with the foundation of the flotation tailings basin dam, and yet the draft permit contains no approvals or conditions concerning the foundation of the buttress. The draft permits are a shell, and the design details required by law are simply missing.

As noted above, Minnesota law does not allow for this kind of piecemeal sequencing of permit approvals. But they go further than that. Minnesota Statute § 103G.315, subd. 6 states that the applicant has the burden of proving that the proposed project is reasonable, practical, and will adequately protect public safety and promote the public welfare." The Commissioner's decision on the application "must be based upon findings of fact made on substantial evidence."[228] Minnesota Statute § 103G.297, subd. 3 is just as clear: a permit for the control of waters of the state for mining copper-nickel ore "may be granted only if the commissioner determines that" the proposal "will not endanger public health or safety."[229] It is impossible and therefore unlawful for the Commissioner to issue the dam safety permits as drafted, when critical design details and approvals are missing from the permits. The applicant cannot meet its burden of proving the project is reasonable and safe when the permit itself states that further data on the strength of the materials used in the dam must be gathered, or that the efficacy of the bentonite cover (which is itself a regulatory requirement of Minn. R. 6132.2200, subp. 2(B)(2)) must be proved at some later date. Similarly, the Commissioner cannot determine on the basis of substantial evidence that the dam proposal is adequate with respect to stability of the foundation and abutments[230] when the permit expressly states that the very design of the foundation and abutments remains to be seen, once further investigations are completed.[231] Such a sequential, piecemeal approach is simply not allowed by law.

[226] Draft Dam Safety Permit No. 2016-1380, Permit Condition Nos. 28, 32, and 33.
[227] Mount Polley Panel Report, supra note 13, at iv (Exhibit 6).
[228] Minn. Stat. § 103G.315, subd. 2.
[229] See also Minn. Stat. § 103G.315, subd. 3 ("If the commissioner concludes that the plans of the applicant are reasonable, practical, and will adequately protect public safety and promote the public welfare, the commissioner shall grant the permit.").
[230] See Minn. R. 6115.0410, subp. 8(D).
[231] Draft Dam Safety Permit No. 2016-1380, Permit Condition No. 30.

But this deferral of regulatory responsibility is not only unlawful, it is unsound policy. The U.S. and Canada have a long regulatory record to draw lessons from, and the pattern of that history is one of regulatory pullback during times of low commodity prices. In periods of low prices, between 30% and 52% of all copper mines become inactive.[232] These are the economically marginal mines that cannot produce sufficient revenue except in boom times, and historically regulators will not enforce permit controls at marginal mines:

> It is generally recognized within the industry that a widespread "cleansing" is both needed and well underway post supercycle metals price peak in 2011. Regulators meanwhile continue to avoid enforcement and duck corrections at these marginal mines hoping for a return of prices that will allow problems to be addressed out of mine revenues that are not likely to ever come again. They fear that enforcement actions may trigger bankruptcy, as occurred at the short-lived re-opening of the Yellow Giant Mine.[233]

But the pattern of cycling marginal mine operations from active to inactive with commodity boom-bust cycles is the very cause of the "trend to ever increasing severity and frequency of catastrophic tailings storage facility failures."[234] Indeed, Mount Polley itself was one of those marginal mines, having reopened in 2005 after a four year period of inactivity.[235] In other words, it is the financial vulnerability of the mines itself that underlies the proximate cause of tailings dam failures. The final precipitating event – the seismic, structural, or hydrological catalyst – is but the final event in a chain beginning with the mine's fragile and marginal economics.

> Overall the association derives from one of the global fundamentals of metallic mining:
>
> Over the past 100 years, the key dynamic of metallic mining globally for all metals has been declining grades and declining prices punctuated by a few short term supercycles. As grades fell across all metals for discoveries, reserves and head grades, economic feasibility and the possibility of profit has turned mainly on the economics of ore production made possible through open-pit mining.[236]

As ore grades and prices have declined over time, the increasing quantities of tailings has interacted with increasingly narrow profit margins to produce mines that effectively need to cut corners in order to make money.[237] Not surprisingly, these cut corners on marginal projects, during a time period when mine waste quantities have been increasingly exponentially, have produced an alarming rise in serious tailings failures, see Figure 1 below.

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232 Bowker and Chambers 2017 (Exhibit 13).
233 *Id.* at 8.
234 *Id.*
235 *Id.*
236 *Id.* at 9.
237 *Id.*

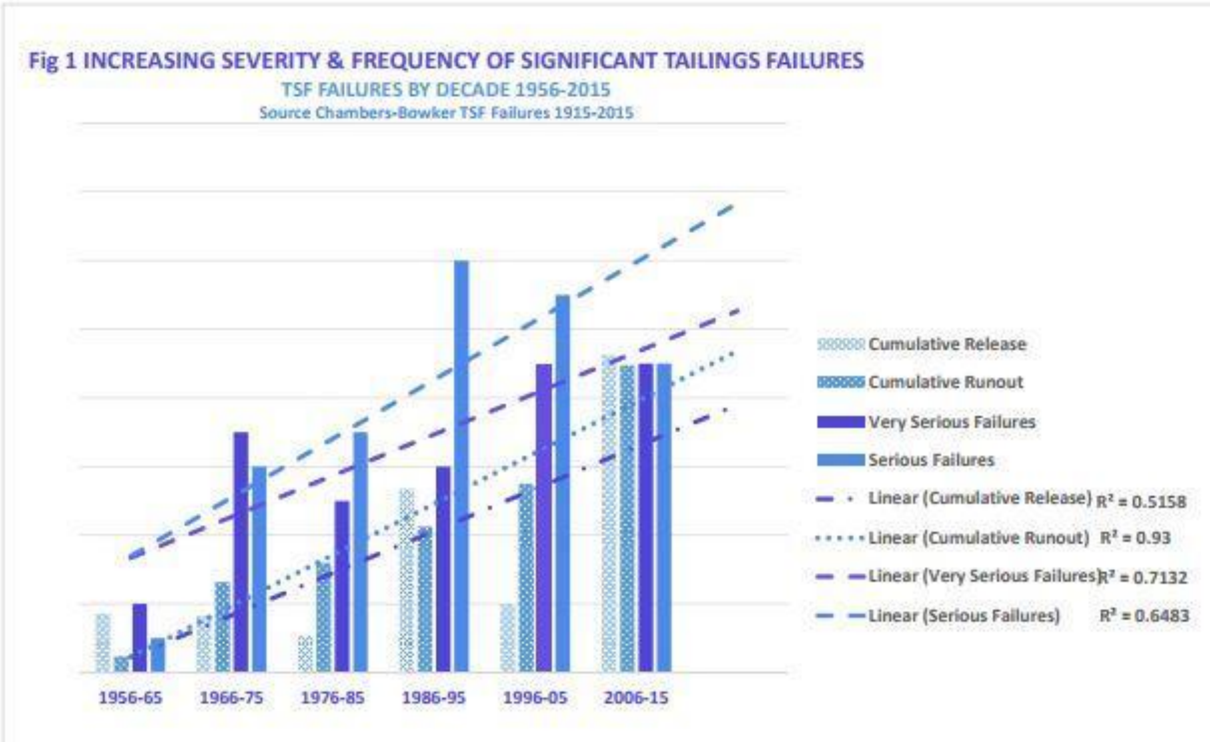

Figure 1 from Bowker & Chambers 2017.

But this relationship goes beyond a broad association. It is also possible to identify mine-level characteristics that are likely indicators of tailings dam failure risk. The volume of ore production and the grade of the copper ore at particular mines is a very strong predictor of serious and very serious tailings failures.[238] The ore grade is particularly predictive of physical problems manifesting at tailings facilities:

> A grade advantage is a critical determinant of ability to survive serious technical flubs. As a norm for all metals, this means that smaller, lower grade mines will suffer more and have more physical manifestations of their economic stress than larger, higher grade mines. Very simply, smaller, lower grade mines operated by junior and midsize miners have less cushion. They have to ride too close to the edge of financial viability viz. global metals markets and major producers to try to stay in production. They also have less access to high quality capital markets, paying more and operating under more onerous terms of credit than the top producers.[239]

These data suggest that tailings failures are a direct function of ore grade, a conclusion that has obvious significance for the Northmet mine project. The "key backstory at Mt. Polley," for example, was one of economic feasibility continually challenged by "poor vetting, shoestring

[238] *Id.* at 9-10.
[239] *Id.* at 13.

economics and production schedules ahead of safety."[240] The life of mine average copper grade for Mount Polley was 0.38, less than what was expected and far less than the global average of 0.70.[241] The expected ore grade for the NorthMet project is 0.28%.[242]

In the briefest form possible, the point is this: global trends in copper mining show declining ore grades, increasing quantities of mine waste, and narrowing profit margins that put most mines on the knife edge of economic viability. These trends have caused a corresponding increase in serious tailings dam failures such as the Mount Polley and Samarco disasters, as mine operators have increasing difficulty meeting unforeseen technical challenges and adapting to changing circumstances at the tailings site. But amidst these worrying trends, Minnesota stands on the verge of permitting its very first copper-nickel mine, and in permitting one of the most critical safety features of the mine – the tailings and HRF dams – it has noticed a draft permit that fails to include any approvals or permit conditions concerning water management, additional materials testing to establish stability of the dams, the design of the buttress, the contingency action plan, operation and maintenance plan, or the proposal to cap the tailings dam with bentonite. It would also allow the operation of an impoundment to contain slurry mine waste in perpetuity. This approach to permitting invites disaster:

> There is a clear consensus among the world's top mining analysts that we have crossed the threshold into a new and as yet unclear era of mining. If it is understood at all, the industry, its regulators and even its key investment analysts have not publicly recognized that present discovery and as milled grades have reached levels that are beyond presently known technology that had previously worked to create economic viability for low grade large scale mines. No regulatory agency known to us has recognized the need to reexamine the large scale low grade mining projects like KSM, Pebble, and Polymet that were originated in the frenzy of the supercycle on assumptions that were never proven in the first instance, and which are very clearly no longer true. No regulatory agency known to us has recognized that the supercycle was a time of pushing marginal mines and their existing infrastructure beyond design capacity and that, as at Mt. Polley and Samarco, those are practices in which failure incubates and matures.[243]

We respectfully urge the DNR to decline to follow that well-trod path and to take actions to protect the public, now and in the future, by modifying the draft permits to require dry stack tailings or to otherwise deny those permits.

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240 *Id.*
241 *Id.* at 14.
242 Updated NI-43-101 Technical Report on the NorthMet Deposit, Minnesota, USA, AGP Mining Consultants Inc., at 25-3 (Jan. 14, 2013), attached as Exhibit 32.
243 Bowker & Chambers 2017 at 17 (Exhibit 13).

4.0 Contested case request

Minnesota law allows the DNR the discretion to order a Chapter 14 contested case proceeding for dam safety permits. Minnesota Statute § 103G.311 states that a hearing must be conducted unless waived on application.[244] We respectfully submit that the legal and factual issues raised in these comments warrant the DNR's exercise of discretion to order a contested case hearing pursuant to its statutory authority.

Because the legal and factual issues raised in these comments are so intertwined with issues covered in separate permits, however, we also suggest that efficient use of stakeholder resources would require at a minimum that the same fact-finder oversee contested cases on the dam safety permits and the permit to mine. As but one example, as noted above, the most significant predictors of tailings dam failures are econometric. In short, economically marginal mines, with higher volumes of ore production and lower grades of ore, are much more likely to suffer tailings failures. This pattern "suggests a significant public interest in giving independent authoritatively verified economic feasibility a specific and prominent place in mine and mine expansion approval, and in life-of-mine and life-of-facility regulatory oversight."[245] This poses a conundrum for the DNR in this matter. One of the key determinants of whether these proposed dams can operate safely and protect the public health and welfare is a feature of the mine plan that is addressed in a separate permit proceeding – the permit to mine. It is in the permit to mine that financial assurance is determined, hopefully based on updated economic feasibility studies that will specify whether this is a financially marginal project that is more likely to fail, or whether it is a financially robust project that can survive technical difficulties and price fluctuations.[246] Accordingly, we respectfully request that the Department exercise its discretion to order a contested case hearing for the dam safety permits, and that the legal and factual issues common to multiple permits (such as the dam safety permits and the permit to mine) be decided by the same fact-finder.

5.0 Contents of the Record

MCEA submitted a Data Practices Act request to obtain the administrative record for the dam safety permits noticed for comment. We received Phase 1 production of that record on September 27, 2017, and Phase 2 production on October 12, 2017. Our review of that record is currently ongoing, but will not be complete prior to the end of the comment period on October 16, 2017. Accordingly, we incorporate by reference the contents of the Department's response to that data practices act request to ensure it is made part of the administrative record for the Department's dam safety permit decisions. Because these documents originated with the DNR, they are before the Department and available to it. However, if you require a hard copy of those records to ensure they are made part of the record for this matter, please let us know and we will provide it to you.

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244 Minn. Stat. § 103G.311, subd. 1, 4.
245 Bowker & Chambers 2017 at 12 (Exhibit 13).
246 *Id.* at 12.

6.0 Conclusion

For the foregoing reasons, the undersigned organizations respectfully request that you deny the permits, or, in the alternative, issue a permit containing a condition that requires a tailings storage design that reflects the Best Available Technologies recommended by the Mount Polley Expert Review Panel, including the elimination of surface water from the impoundment, the promotion of unsaturated conditions in the tailings with drainage provisions, and the achievement of dilatant conditions throughout the tailings deposit by compaction. Failing either of those options, we urge you to adopt the recommendations of Mr. Kuipers, who argues that a managed risk approach proposed by the company must be approved only after receiving the informed consent of those people whose lives and livelihoods would be impacted by a failure of either of the proposed impoundments.

Thank your for your consideration of these important matters.

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