1. Aquila has chosen the upstream design to store its mine tailings. The upstream design is the lowest cost option but the most prone to failure, according to experts. About 76% of tailings dam failures worldwide are related to upstream construction methods (International Commission on Large Dams, 1996, bulletin 104, “Monitoring of tailings dams, review and recommendations).

On January 25, 2019, a 28-story high tailings dam in Brumadinho in southeastern Brazil, failed, releasing almost 3 billion gallons of sludgy mine waste that killed about 270 people. This is Brazil’s deadliest-ever mining accident. The same design for storing mine waste, known as the upstream dam construction method, is now being proposed for the Back Forty project. In the weeks after the accident, Brazil’s government banned new upstream mining dams and ordered that Brazil’s 88 upstream dams be taken down or converted into other types of dams. (Jake Spring, “Brazil set to ban upstream tailings dams after collapse kills hundreds,” Reuters, February 7, 2019.

“We absolutely agree that a fundamental change is required in the industry’s collective approach to safe tailings management,” said BHP’s CEO Andrew Mackenzie. BHP is the world’s largest mining company.

“I’m paranoid about tailings dams,” said Mark Bristow, CEO of Barrick Gold Corporation, the world’s largest gold miner, which has assigned full-time engineers to each tailings dam. (Ernest Scheyder, “Brazil Tailings Dam Disaster Pushes Mining CEOs
Instead of steel and concrete, as is typical in large dams at reservoirs holding water, mining dams are made of mining waste itself, band upon band of compacted sludge. The only reason the upstream design is considered the lowest-cost option is because mining companies fail to assess the social and environmental costs of a collapsed dam. Aquila’s financial assurance cost only covers costs for the end of the construction operating period and the Life of Mine operating period.

“American International Group (AIG) has cut back the vast majority of its mining liability business following deteriorating loss ratios in the class, driven in part by the most recent tailings dam disaster in Brazil, earlier this year.” (Gavin Bradshaw, Insurance Insider, June 3, 2019).

2. Upstream embankments are not suited to areas of seismic activity. According to the Golder report in Appendix C of the amended application, “With the upstream construction method, tailings liquefaction represents a potential mode of failure, which needs to be evaluated.” Liquefaction, or the sudden loss of strength when tailings sands are loaded and cannot drain, can be triggered by seismic events, such as an earthquake. When liquefaction occurs, “a solid material seemingly resting safely in place can abruptly become a murky liquid, flowing downhill and destroying nearly everything in its path,” as happened in the January 25 tailings dam disaster in Brazil (see “A Tidal Wave of
Dr. Gedicks  
Talking Points for 6/25/19 Hearing  
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Mud,” *New York Times*, February 10, 2019). Chile, Peru and other earthquake-prone countries ban the design because even small seismic activity has been shown to affect tailings dams.

3. Aquila’s dam safety permit application 2L, Section 2.5 states that “the project is located in an area of low seismicity,” citing the U.S. Geological Survey Seismic Hazard Maps published in 2014. However, this guidance by the USGS is not intended for tailings dams or other long-term structures, but are intended to assist engineers and planners who design buildings. Higher performance standards are required for structures containing substantial quantities of hazardous contents, to prevent uncontrolled release of these materials.

The USGS has released a draft for new maps in 2018, which will update their 2014 modeling. The draft maps show that many areas, including the Midwest, will see some increase in seismic risk. In regions subject to seismic shocks, failure of upstream dams by liquefaction can occur at very low dam heights.

4. According to Dr. David Chambers, an internationally-recognized expert on tailings dam failures, Aquila’s seismic risk analysis did not do either a probabilistic or determinist analysis to determine the largest ground motion that the tailings dam structure could experience. The International Commission on large Dams recommends that tailings dams be designed to withstand the maximum Credible Earthquake or the 1 in 10,000-year event. By using the 1 in 2,475-year seismic event instead of the 1 in 10,000-year event, **Aquila significantly underestimates the size of the seismic event the tailings dam**
could experience. The use of the 1 in 2,475-year seismic even
analysis, are viewed as unacceptable for tailings
impoundment design in most regulatory jurisdictions.

5. Aquila’s dam safety permit application asserts that the project is
located in an area of low seismicity but fails to mention that in
2010, a massive split in the ground, called the “Menominee
Crack” mysteriously opened just north of Menominee and is
considered to be the result of a small earthquake (see Becky
Oskin, “What Caused This Weird Crack to Appear in
Michigan?” Live Science, February 9, 2010; Samantha
Matthewson, “Menominee Crack: Michigan Researchers
Finally Identify Mysterious Pop-Up Feature,” Nature World
News, February 11, 2016; Joshua P. Richardson et. al.
“Menominee Crack: Bedrock Pop-Up Event near Menominee,
The split, which measures almost 360 feet long and 30 feet wide
at its largest point, formed in October 2010 following a
magnitude-1 earthquake. Scientists from Michigan
Technological University proposed that this seismic event,
which they called a “pop-up,” probably occurred “when
underground pressure on the limestone rock in the areas was
released.”

It appears that numerous historical seismic events relevant to the
Back Forty’s location in the Upper Michigan were not included
in the seismic risk analysis. Aquila includes no mention of
historical seismicity events of regional importance, and limits
the analysis to “a design earthquake magnitude of 5.94, which
corresponds to a return period of 1:2,475 years.” For permanent
tailings waste structures, according to Dr. David Chambers, a 10,000-year return period is recommended.

6. Tailings dams are constructed in sequential “lifts” over several years that make quality control more challenging, relative to water supply dams that are constructed all at once. The diagrams of the operational tailings management facility (TMF) in the Mine Permit Amended Application, Figure 2-2, show increasing elevation to the very top of the TMF. According to Dr. David Chambers, this would not seem to be feasible given the approximately 35% moisture content of tailings.

7. Unlike conventional dams that have a finite life, tailings dams have to be designed and constructed to last “forever” and require some degree of surveillance and maintenance long after the mining operation has shut down and generation of cash flow and profit has ended.

Aquila fails to disclose what the life of the liners in the tailings and waste rock management facility is expected to be and what will happen in the likely result of the failure of the liners. Tailings impoundments have been using plastic liners for only 35 years, and the leakage or seepage of lined tailings impoundment facilities is already a known problem. Leaking tailings liners are “commonly underestimated” according to the EPA, resulting in leachate seepage and the transport of contaminants into groundwater.

The liners to be used in the Back Forty tailings management facility (TMF) have “no lifetime guarantee” according to an industrial liner manufacturer. Plastic liners will also be
adversely affected by acidic chemistry of the TMF. Liners have a finite life, and will fail following the closure of the TMF, when the resources available to remediate the failure will be limited.

Why should the people who live downstream of a possible tailings dam failure have any confidence in Aquila’s surveillance and maintenance of the tailings dam when Aquila has already demonstrated their inability or unwillingness to keep track of their own monitoring wells which are used to monitor groundwater? It was a local citizen who reported that 20 locks had been removed from monitoring wells at the Back Forty project in April 2019. Further investigation revealed that Aquila had cut off the locks but never reported this to the DEQ. When Aquila’s Dan Blondeau was asked if the absence of locks could have potentially led to an increased chance of wells being tampered with, polluted or contaminated, he had no response4. (see “Concerns about missing Aquila locks addressed,” *Eagle Herald*, May 9, 2019).

8. Aquila says that the tailings management facility proposed at the Back Forty project is very different from the typical traditional upstream raised tailings facility. According to Aquila, the facility was specifically designed to mitigate the known risks of traditional upstream tailings facilities. Specifically, the perimeter wall will not be constructed of tailings, but of waste rock “which is strong, free-draining, non-liquefiable and erosion-resistant.” (Golder report on Tailings Management Facility, 3.2.1 Design Criteria, October 30, 2018).
However, in Aquila’s Mine Permit Application, the company admits that 75% of the waste rock is expected to be acid-generating. Dr. David Chambers asks: How will Aquila ensure that the embankment itself does not contribute to acid and metal leaching?

According to the National Park Service, tailings dams are not designed to be free-draining after facility closure. “For potentially acid-generating tailings it is usually the objective to keep this material saturated after mine closure, because saturation is the best way to limit oxygen and minimize the acid-generation process. Even if tailings dams were designed to be free-draining, it is likely there would be some residual level of saturation (the phreatic level) in the tailings, because of their fine composition and low permeability. The residual phreatic level (water in a zone of saturation) would likely mean the lowest level of tailings would remain saturated. Should the dam fail due to a large seismic event, liquefaction of the lowest level of tailings would probably lead to a large tailings release through a ruptured dam.” (see U.S. National Park Service, “Long-term Risk of Tailings Dam Failure,” June 15, 2015. 
https://www.nps.gov/articles/aps-v13-12-c8.htm )

9. Aquila has seriously underestimated the risks to upstream dams from heaving rains. James Kuipers, principal consulting engineer at Kuipers and Associates, states that heavy downpour can rapidly increase the weight of the material inside the dam and liquefy relatively dry mine waste that can then spill out, overwhelming and drowning people in its path. Kuipers is a consultant with the EPA and state governments on tailings dams.
In his review of Aquila’s Mine permit Amended Application, Stephen Hoffman, Senior Environmental Scientist with SHoffman Consulting, notes that the tailings perimeter external sump and ditch were designed to meet a 100-yr 24-hour event. “Such a design is not adequate to reflect current rainfall/snow events in the area.”

In the Golder report on the “Amended Design of the Tailings Management Facility,” they state that the mean annual precipitation of the site is approximately 31.3 inches and that the average annual lake evaporation for the Project site is 26 inches. Yet recognized experts in tailings dam design state that “upstream tailings dam design should be prohibited in areas where net precipitation exceeds net evaporation.” According to Dr. David Chambers, upstream tailings dams have demonstrated that they pose an unacceptable level of risk of failure in these areas. Michigan regulators need to explain to the public why this prohibition should not apply to the Back Forty project.

Hoffman also notes that the design of the Contact Water Basic (CWB) assumes the basin will hold a 100-year 24-hour event and that during a Probable Maximum Precipitation (PMP) event, water from the CWB will flow into the mine pit. Under such a PMP event, how much water would be contained in the pit, how long would it take to pump it out, and does the Waste Water Treatment Plant have the capacity to treat such a large flow? Or would such flows be allowed to be discharged without treatment under an “emergency” situation?

Aquila’s Amended Contingency Plan (March 2019) states that the release of Leachate or contact water to the environment
could pose a threat to wildlife in and near the project area by impacting surface water and/or groundwater quality. However, the plan dismisses any threat to people by asserting that the project is located in a remote, sparsely populated area, and therefore the release of contact water or Leachate would have “minimal affect to local residents.” (p. 3)

Aquila goes on to state that any spills will be reported to the Michigan DEQ and Aquila will implement emergency spill response. There is no information about what Aquila would actually do in the case of a spill except to say that the general manager at the facility will be designated the Incident Commander and will be responsible to ensure that emergency response actions are carried out in an appropriate and timely manner.

Aquila minimizes the potential for external erosion of the tailings dam from the runoff of rain water by using 18-year-old data on the severity of storms. This defies science and common sense. Heavy rain has been implicated in 25% of global and 35% of European tailings dam failures (see M. Rico et. al, 2008. “Reported tailings dam failures: a review of the European incidents in the worldwide contest,” *Journal of Hazardous Materials*, 152, pp. 846-852).

10. The Mine Permit Amended Application does not explain how seepage from the tailings dam will be managed post-closure, except for the first 10 years post-closure, when the water treatment plant will be operated. Given past experience with totally-lined waste impoundments, it is likely that both the amount of long-term seepage, and the time necessary to drain
and treat the initial tailings drain-down, are likely underestimated. There is no way to predict that treatment can be terminated after 120 years; 10 years is at best a guesstimate.

Failure to manage seepage through the tailings dam **can result in piping**. This occurs where exiting seepage flows pick up soil particles and move them out of the foundation or embankment. The continued removal of soil particles causes the unseen development of channels or pipes in the embankment or foundation. When these pipes connect back to the free water in the reservoir, very large flows develop along the pipe, and complete failure of the dam may occur.

11. **Aquila** has stated that the design of the Tailings Management Facility (TMF) and the Waste Rock Facilities (WRF) provided in Appendix C of the Mine Permit Amended Application (MPAA) has employed technologies that can effectively store and manage tailings, waste rock, and contact water, thereby reducing its risk of exposure to the environment or affect to public health.

This assertion is not supported by the evidence. The number of tailings dam failures has doubled in the past 20 years. There have been 46 in the past 20 years, and the number has been rising steadily (see Margaret Armstrong et. al., “Why have so many tailings dams failed in recent years?” *Resources Policy* 63, (2019) 101412.

A recent study of catastrophic mine waste disasters reveals that these failures are increasing in frequency, severity and costs all around the world. Nearly half of all recorded “serious failures”
happened in modern times, between 1990 and 2010. “These failures,” according to Dr. David Chambers, “are a direct result of the increasing prevalence of TMFs with greater than a 5-million cubic meter total capacity necessitated by lower grades of ore and higher volumes of ore production required to attain or expand a given tonnage of finished product.” (see https://files.dnr.mn.us/input/environmentalreview/polymet/request/exhibit3.pdf)

In Aquila’s original Mine Permit Application, they proposed to store 5.1 million cubic meters of tailings, thereby increasing the risk of a tailings spill, according to the scientific literature. In Aquila’s Amended Application, they propose to store 4.9 million cubic meters of tailings, despite the increased size of the tailings dam. The 4.9 million estimate does not take account of the company’s stated plans for an underground mine after the excavation of the open pit.

If Aquila proceeds with an additional 9 years of underground mining, the TMF will need to accommodate additional waste. Would the current TMF design accommodate additional tailings? Would the TMF walls be raised, or would an additional TMF need to be constructed? Would the external “downstream” footprint of the TMF wall need to be expanded or reinforced to support additional raises? Specifically during the raises, when dam stability is weakest, what is the Factor of Safety? This was not addressed in the Dam Safety permit, and not clear in the Mine Permit Amended Application.

TMF impoundments are frequently expanded through additional raises, which greatly increases the height of the dam walls and
the total volume of waste rock and water contained within the structure. **This habit of incremental raising greatly exacerbates the problem of instability, and has resulted in the catastrophic collapse of several tailings dams.**

Strict impoundment limits were not defined in the Back Forty Mine Permit Amendment Application. It is thus reasonable to assume that Aquila has selected the controversial “upstream dam” method because it could allow for sequential expansion through raising of the dam wall. The tailings dams at Brumadinho, Brazil and Mount Polley, British Columbia were raised higher than originally designed, multiple times.

A study of four recent tailings dam failures in countries with a strong mining tradition (Los Frailes in Spain, Mt. Polley in Canada, Samarco and Brumadinho in Brazil) showed that production had been increased and/or cost-cutting measures had been put in place before the accidents. Why should cost-cutting and increasing production lead to the rising number of serious tailings dam failures? The study suggests that the management compensation packages which reward cost cutting and increasing production so as to increase their annual bonuses are playing a role by encouraging managers to take risks. (see Margaret Armstrong et. al., “Why have so many tailings dams failed in recent years?” *Resources Policy* 63, (2019) 101412.

12. Mining companies routinely produce dam breach analyses as part of their environmental impact assessments for new projects or tailings management facility (TMF) expansions. Yet the
word “breach” in relation to the TMF facility is never mentioned in the Mine Permit Application Amendment (MPAA).

Failure of the TMF would obviously have major, permanent impacts on the land surrounding the mine site, and on the Menominee River. Toxic tailings sludge would be discharged downriver, poisoning the water and destroying the aquatic habitat from the mine site all the way into Lake Michigan. The downstream communities of Menominee, Michigan and Marinette, Wisconsin would be severely impacted. Yet Aquila has failed to complete an analysis of what the environmental, social and economic impacts of a partial breach or total collapse of the TMF would be. Why has such an analysis not been required as a condition of the dam safety permit?

13. Aquila has failed to account for gaseous mercury emissions from the tailings pond, because they are not anticipating such emissions. This is inconsistent with scientific research showing that mercury emissions from tailings ponds, open pits and waste rock dumps make up nearly 20% of the mercury emissions from a mine site (see Adella Harding, “Study looks at fugitive mercury emissions, Elko Daily, Nevada, November 23, 2009).

According to the MPAA, about 10% ore oxide ore will be processed that was expected in the original Mine Permit Application (MPA). An estimate of the amount of mercury expected to be emitted to air--along with the form and fate of
the mercury—should be provided, given the MPAA estimate of processing more oxide ore.

Aquila uses old data on mercury deposition in Spring Lake. This may be biasing the baseline high, underestimating the impact of emissions which Aquila says will exceed water quality standards after mining begins.

14. The Back Forty Mine site will be located within a landscape that features significant ancient Menominee Tribal cultural resources, including tribal burial grounds, historic agricultural sites and ceremonial sites. **Mining operations will destroy these irreplaceable resources and irreversibly harm the Menominee River and nearby wetlands.** While responsibility for issuing federal surface and water discharge permits and wetlands permits has been delegated to the state of Michigan, **the federal trust responsibility owed to the tribes has not.**

**Aquila has ignored Menominee treaty rights and is in violation of the United Nations Declaration on the Rights of Indigenous Peoples that requires all extractive resource projects that affect indigenous peoples to obtain the free, prior and informed consent of indigenous peoples.**

Furthermore, the International Union for the Conservation of Nature has affirmed that the sacred natural sites of indigenous peoples should be “No-Go-Areas” for destructive industrial activities like mining and for corporations to permanently withdraw from such areas.

The Menominee Tribe is prepared to ensure the full federal protections of the Clean Water Act and the National Historic
Preservation Act and to ensure that the federal and state
governments do not continue to ignore the Menominee Tribe’s
concerns.

15. “The management and onsite disposal of waste material has not
demonstrated that constituents from the material will be
contained on site, in the manner in which they are disposed.
The methodology in which the Mine Permit Application
demonstrates the modeling and the mobility of these materials is
inappropriate; and, with the limited information available to the
Water Resources Division WRD), it is determined that these
materials will be transported through groundwater and discharge
at the land and water interface—resulting in an adverse impact
to the resource. **With the data available to the WRD, this
impact is foreseeable and will result in a long-term
degradation of the aquatic resources on and off the project
site.**” (Water Resources Division of the Michigan Department
of Environmental Quality, “Finding of Fact and Conclusion of
Law,” April 30, 2018).