RESPONSE TO:

TECHNICAL REVIEW OF AQUILA RESOURCES' BACK FORTY MINE PERMIT AMENDMENT APPLICATION CENTER FOR SCIENCE IN PUBLIC PARTICIPATION (CSP2) FEBRUARY 11TH, 2019

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"Technical Support for Grassroots Public Interest Groups"

01. Summary and Key Points

The Mine Permit Application Amendment (MPAA), which includes and updated Environmental Impact Assessment Amendment (EIAA), were developed to bring consistency between the Back Forty mine facilities layout and activities in the Wetland Permit and the Mining Permit. While some of our concerns were previously documented in our comment on the Wetlands Permit, we have several comments specifically on the MPAA and EIAA.

The key issues are as follows:

- The Tailings Management Facility (TMF) is to be constructed using the upstream dam construction method, which is the least safe design. It also applies an underestimated seismic event to the construction design.
- There are no details for the wastewater treatment plant (WWTP)
- There is no information on how mercury from the retort will be stored or transported, or whether there is a facility to receive it. Mercury emissions from the retort did not go into air deposition modeling.
- Air deposition modeling suggests that Spring Lake currently meets mercury waterquality standards, but will exceed (violate) them after mining begins. By using old data, Aquila Resources may be biasing the baseline high, underestimating the impact of emissions.
- There are significant unexplained inconsistencies with the volume of chemical reagents, and the storage capacity for lime.
- Recent data suggests upper groundwater layers flow faster than the data used in the groundwater model. The groundwater model was not updated, and may underestimate the volume of dewatering and impacts to wetlands.
- Biological monitoring should include mussels, but currently that is not scheduled.
- There are no plans to monitor surface water for metal concentrations, although sediment and mine discharge will be monitored for metals. Surface water metal analysis should be added.
- Financial assurance is underestimated.

01. RESPONSE
Each of the Key points are addressed in the following body of text taken from the CSP2 Technical Review of Aquila Resources' Back Forty Mine Permit Amendment Application Dated February 11th, 2019. Aquila has assigned section numbers to the document headings to correspond with the responses.

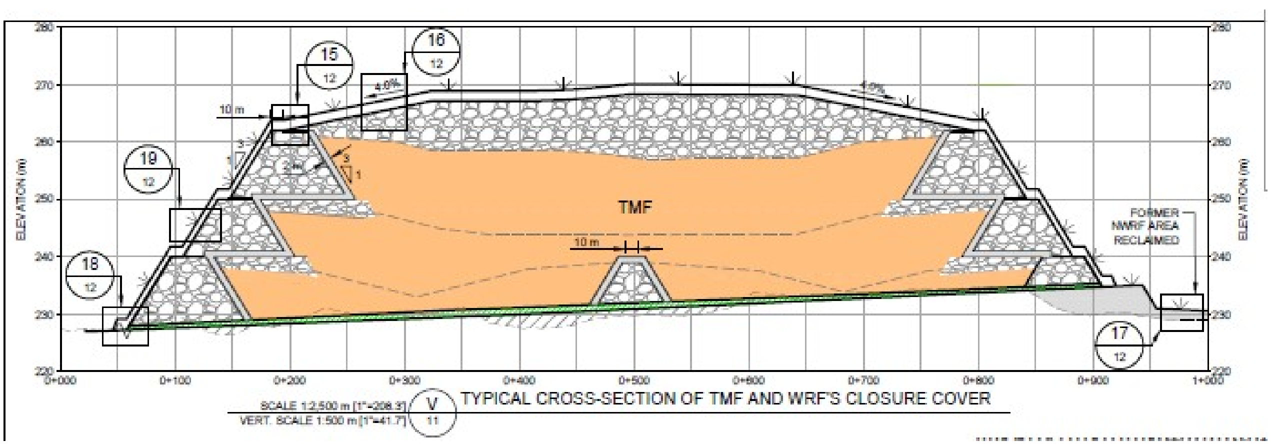
02. Tailings management facility (TMF)

Going back to the **2015 Environmental Assessment**, three alternatives to the tailings facility were considered, and dismissed:

1. Conventional tailings disposal in slurry form, because of the; "… very large space requirement for the basin; the need for a water management basin adding to space needs; potentially higher fresh water needs; and higher potential for seepage from the tailings basin;
2. Thickened tailings disposal in slurry form, because; "… increasing capital and operating costs for additional equipment." and,
3. Filtered (dewatered) tailings stored as a dry stack, because; "The filtering and placement costs are very high …" (Foth 2015, p. 58)

02-1. Upstream TMF dam construction

The primary issue with the tailings facility is its construction method as described in the **Dam Safety Permit Application 2L** (Golder 2018).



TMF Cross Section (Golder 2018, Figure 12)

As seen in the figure above, the tailings facility cross section is that of upstream design; that is, the tailings themselves form the support for a significant part of the impoundment. These tailings will nominally be dry after closure, but it is possible for lenses of saturated tailings to exist because the tailings are not mechanically compacted after placement.

Upstream-type construction has proven itself to be the most vulnerable construction type to catastrophic failure. This is the type of construction that was employed at the recent tailings dam failure in Brazil, where the death toll is over one hundred, and is likely to rise significantly higher.

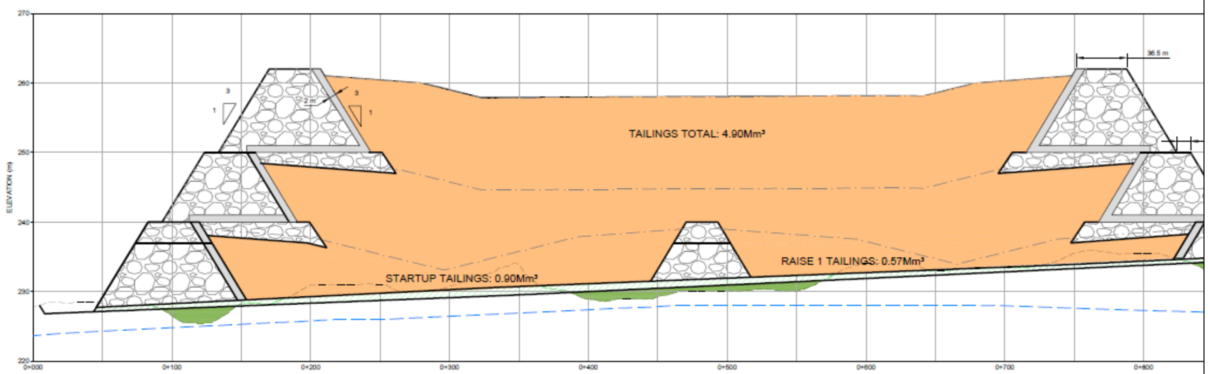
- Using downstream (the safest) or centerline (the next safest) construction was not considered in the Dam Safety Permit Application, MPAA, or the EIAA. The primary reason to use upstream- type construction is save money. Any time tailings are used for structural support, the risk of failure is increased over that of mechanically engineered materials. It is not clear from the Dam Safety Permit Application, MPAA, or the EIAA why the cost savings gained with upstream impoundment construction is more important than the increased long-term risk to the public of impoundment failure. **It is significant that use the downstream or centerline construction for the impoundment was never raised.**

There is expected to be more potentially acid generating (PAG) waste rock than non-acid generating (NAG) waste rock. In the MPA, 75% of the waste rock was expected to be PAG.

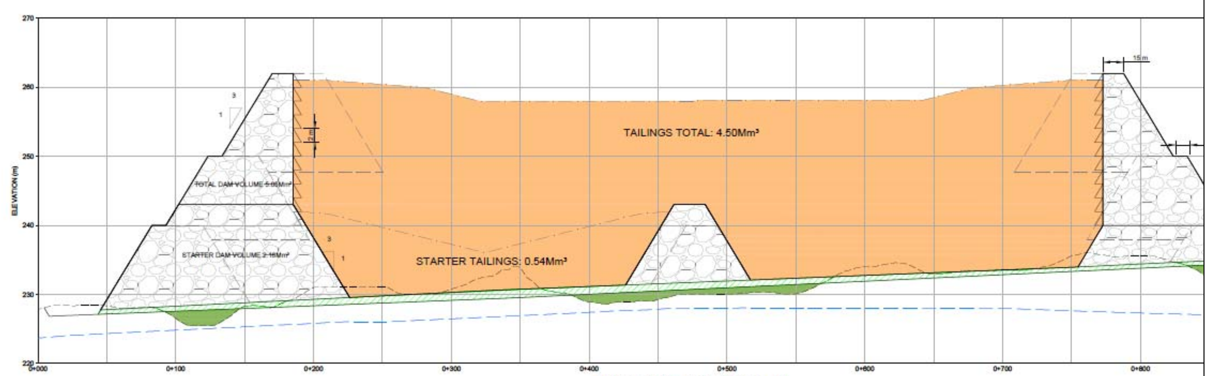
- If centerline or downstream dam construction was required, would there be enough NAG rock for the dams?

02-1. RESPONSE

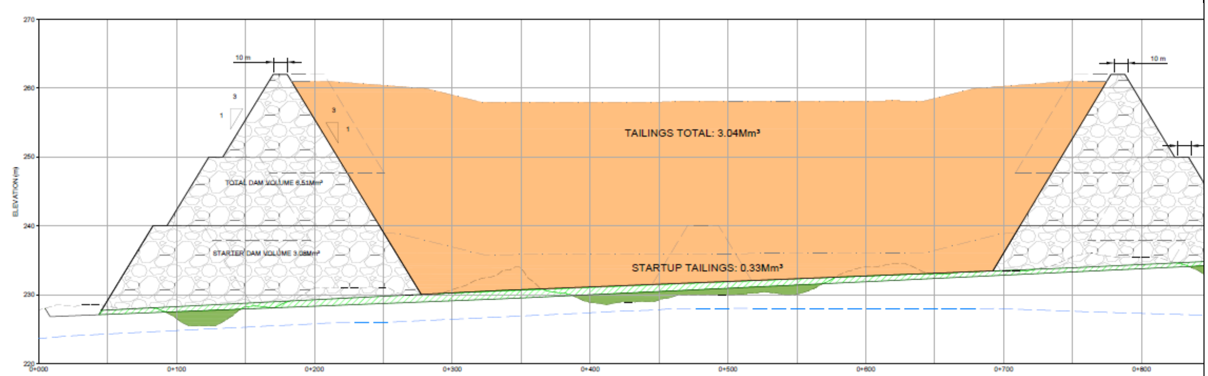
The upstream, centerline, and downstream dam raise options were considered for the project. The life of mine tailings is approximately 4.9Mm^3. Only the upstream raise option managed to store all of the tailings within the limited footprint area available. The centerline dam raise method can only store 4.5 Mm^3 and the downstream dam raise method 3.0 Mm^3 as shown in the figures below. The factor of safety for stability of the selected design is actually higher than that for the centerline design.



UPSTREAM RAISED PERIMETER WALL



CENTERLINE RAISED PERIMETER WALL



DOWNSTREAM RAISED PERIMETER WALL

The tailings management facility proposed at Back Forty is very different from the typical traditional upstream raised tailings facility. The facility was specifically designed to mitigate the known risks of traditional upstream raised tailings facilities. The perimeter wall will not be constructed of tailings, rather it will be constructed of a continuous zone (at least 33m thick) of waste rock which is strong, free draining, non-liquefiable and erosion resistant. The upstream slope the perimeter wall will have transition and filter zones which will allow tailings consolidation water to easily drain out of the facility and eliminate the risk of tailings migration into the perimeter wall. A granular drainage layer will cover the entire base of the facility and will be graded to convey the seepage into an external sump by gravity. The tailings will be thickened to about 70% solids content in the mill which will reduce the volume of tailings water coming to the TMF by 3 Mm^3. The free draining underdrain and perimeter wall as well as pumping of bleed water from decant area will result a low phreatic surface. Conservative seismic and static liquefaction analyses were carried out and confirmed the stability of the facility. The performance of the facility will be monitored closely during construction and operations to ensure that the design intent is being satisfied.

02-2. Seismicity

Seismic analysis for large structures with long design lifetimes, like dams (especially tailings impoundments), typically undergo both probabilistic and deterministic analyses to determine the largest ground motion that the structure could incur. Neither a probabilistic or deterministic analysis was done for the Back Forty project. Instead, Golder (2018) determined:

> *"The Project is located in area of low seismicity. The site Peak Ground Acceleration (PGA) is estimated according to the U.S. Geological Survey - 2015 National Earthquake Hazards Reduction Program (NEHRP) Provisions (USGS 2016). The estimated PGA for the site at 1 in 475 year and 1 in 2,475 return periods are 0.01g and 0.034g, respectively."* (**Dam Safety Permit Application 2L, Section 2.5)**

We assume this statement is referencing the USGS National Seismic Hazard Maps last published in 2014 (USGS 2014).[1] 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:

> *"The maps are used in building codes (for example, Building Seismic Safety Council, 2009) to identify areas where built structures are likely to experience large seismic loads and to allow for prudent allocation of resources by reducing waste resulting from over-built structures."* (USGS 2014, p. 1)

[1] Of interest is that the USGS 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.

The International Commission on Large Dams recommends that dams be designed to withstand the Maximum Credible Earthquake, or the 1 in 10,000-year event (ICOLD 2008). By using the 1 in 2,475- year seismic event, instead of the 1 in 10,000-year event, the size of the seismic event the tailings facility could experience is being significantly underestimated.

- **The use of the 1 in 2,475-year seismic event for the design basis event, and lack of probabilistic seismic analysis, are viewed as unacceptable for tailings impoundment design in most regulatory jurisdictions.**

02-2. RESPONSE
The Project is located in area of low seismicity. Design seismic events are typically chosen based on the hazard classification of the tailings dam. The 1 in 2,475-year seismic event was chosen for the Back Forty TMF in accordance to the CDA hazard classification. This is standard industry practice used around the world. Regardless of the design seismic event selected, the Pseudo-static factor of safety obtained is over 2.5 for all the cases analyzed compared to the minimum required factor of safety of 1.1.

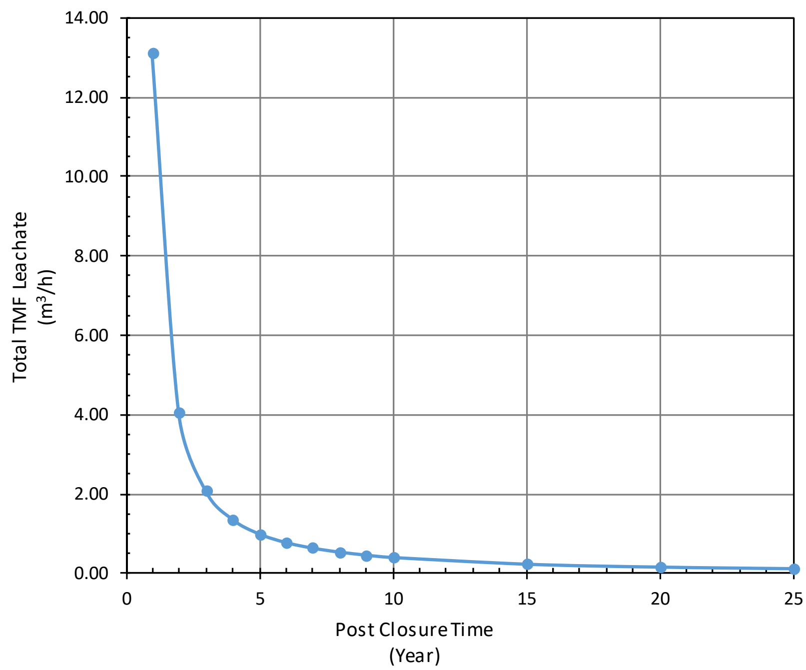
02-3. TMF seepage

In all of the above approaches (conventional, thickened, and filtered), lacking a bottom liner, seepage from the tailings would contaminate groundwater. The proposed tailings impoundment has a bottom liner that should protect groundwater. After mining, a liner will be placed on top of the tailings facility to greatly limit (but not completely prevent) water from entering the tailings. Once the tailings have been drained, there will be a limited amount of seepage long-term from the tailings that will need to be treated, most probably in perpetuity.

The **MPAA** does not explain how this seepage will be managed post-closure, except for the first 10 years post-closure, when the closure 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.

02-3. RESPONSE

Geotechnical laboratory testing (i.e., Rowe cell consolidation tests) carried out on the Back Forty tailings showed that tailings consolidate relatively quickly. This is due in part to the high specific gravity of the tailings. The tailings will be discharged at a high solids content, which means that the initial settled density of the tailings will be higher than normal. Once in the facility, the perimeter wall and the drainage layer at the bottom of the facility will provide a 3D drainage pattern which will further enhance the rate of dewatering of the tailings. The figure below shows that the volume of seepage that will report to the bottom of the facility will decline rapidly over time and will quickly become negligible post closure. In any case, any seepage will be collected in a sump and monitored.



03. Financial Assurance

03-1A Financial Assurance Model

There are a number of cost calculation spreadsheets, both in the private and public domains, which have been developed to calculate financial assurance for closure and post-closure. Probably the most widely used reclamation financial assurance is the Nevada Standardized Reclamation Cost Estimator, developed by the Nevada Division of Environmental Protection.

A financial assurance calculation has been provided in **MPAA Appendix H.** The model used to calculate this estimate is not noted, and the details of the calculation are not provided. Even if we blindly assume the calculations for the basic reclamation costs are accurate, there are still two significant issues with the calculation of the post-closure financial surety.

03-1A. RESPONSE
The detailed financial assurance cost model and estimate for the Back Forty Project is provided in Appendix H of the MPAA, and includes closure quantities along with unit costs based on contractor quotes incorporated into the project construction cost model that was prepared for the NI 43-101 Feasibility Study. The project construction cost model is specific to Menominee County and was deemed more appropriate that the Federal BLM or Nevada SCRE models to inform reclamation cost estimating. The indirect cost guidelines recommended by BLM and SCRE and others are considered and discussed below.

03-1. Indirect Costs

First, the only indirect costs added to the basic calculation amount of $98,313,604 are 5% for MDEQ Administrative Costs, and 5% for Contingency. This is 10% for total indirect costs.

INDIRECT COST GUIDELINES

Recommended Percentage of Reclamation Costs

	CSP2[1]	**USFS[2]**	**BLM[3]**	**SCRE[4]**
Contractor Profit	10%	15% - 30%	10%	10%
Scope/Bid Contingency	10%	14% - 50%	15%	4% - 10%
Mobilization/Demobilization	0% - 10%	0% - 10%	---	Direct Cost
Engineering Design & Construction Plans	8%	2% - 10%	4% - 8%	4% - 8%
Performance Bond Cost	5%	3%	3%	3%
Liability Insurance			1.5% of Labor	1.5% of Labor
State Sales Tax on Direct Costs	---	0% - 5%	---	---
Agency Administration	10%	4% - 14%	6% - 10% + 1.26% - 2.1%	6% - 10% + 1.26% - 2.1%
Annual Inflation	3%	1% - 6%	---	---
	======	======	======	======

Total Indirect Costs	46% - 56%	39% - 128%	29% - 44%	29% - 44%
References:				
[1] Hardrock Reclamation Bonding Practices in the Western United States, James R. Kuipers, PE, Center for Science in Public Participation, February 2000.				
[2] Training Guide for Reclamation Bond Estimation and Administration, for Mineral Plans of Operation Authorized and Administered Under 36 CFR 228A, USDA Forest Service, Minerals and Geology Management, April 2004.				
[3] BLM Handbook H-3809-1, Surface Management Handbook, Department of Interior, Bureau of Land Management, September 17, 2012.				
[4] Nevada Standardized Reclamation Cost Estimator (SRCE), 2015, http://www.nvbond.org/				

Above is a table that list published sources for indirect cost estimates: the Center for Science in Public Participation (our organization), the oldest of the references; the US Forest Service; the Bureau of Land Management; and, the Nevada Standardized Reclamation Cost Estimator, probably the most widely used reclamation cost calculator. The lowest "minimum" total indirect cost comes from the BLM at 29%, which is still almost three times the amount of indirect costs estimated for the Back Forty Project.

- **The Back Forty indirect cost estimate is lacking cost estimates for Mobilization/ Demobilization; Engineering Design & Construction Plans; Contractor Profit; and, Annual Inflation.**

03-1. RESPONSE

As mentioned, the financial assurance cost model and estimate is based on the project—specific construction costing model, which is in alignment with quotes and estimates received by local contractors and consultants for project construction activities defined in the Feasibility Study, and in the MPAA. The estimate includes indirect costs, and addition to an allowance of 5% for MDEQ administration plus 5% for contingency.

The following indirect costs items were mentioned in the comment:

Contractor Profit: 10-30%

The cost estimates are based on contractor quotes, and include contractor profit margin.

Scope/Bid Contingency: 4-50%

A contingency of 5% was applied.

Mobilization/Demobilization: 0-10%

Mobilization/Demobilization costs were not included in the cost estimate. Only a small portion of the reclamation costs will require significant contractor mobilization. A 1% allowance will be added to the financial assurance cost estimate in lieu of additional potential mobilization/demobilization costs, which aligns with the recommendations.

Engineering Design & Construction Plans: 2-10%

The costs for closure design for the TMF, backfilled pit, and mine site will be presented to the MDEQ with the detailed design and construction documents. The design will be updated as part of annual reclamation reporting.

After a review of the financial assurance cost estimate, detailed engineering for reclamation activities were not directly accounted for. An additional allowance of 2% will be added to the financial assurance cost estimate, which aligns with the recommendations:

Performance Bond Cost / Liability Insurance: 1.5% of Labor – 3%

Bonding and insurance costs were not included in the cost estimate and will be addressed by Aquila through their selection of the appropriate financial assurance instruments.

State Sales Tax on Direct Costs: 0-5%

State sales tax will not be billed by contractors for closure activities.

Agency Administration: 4-14%

An allowance of 5% for MDEQ administration was included in the cost estimate.

Annual Inflation: 1-6%

Inflation to costs were assumed to be equal to inflation in the financial assurance bond, and were therefore not accounted for.

Total Indirect Costs: 29-128%

As discussed, several of the indirect costs items that were mentioned were already accounted for in the financial assurance cost estimate. However, an additional 3% of potential indirect costs were identified, and will be added to the financial assurance cost estimate as follows:

EOC: $20.3M
5% MDEQ Admin: $1.0M
5% Contingency: $1.0M
3% Additional Indirects: $0.6M
New Total: $22.9M (from 22.4)
EOC: $98.3M
5% MDEQ Admin: $4.9M
5% Contingency: $4.9M
3% Additional Indirects: $2.9M
New Total: $ 111M (from 108.1)

03-2. Post-Closure Water Treatment Costs

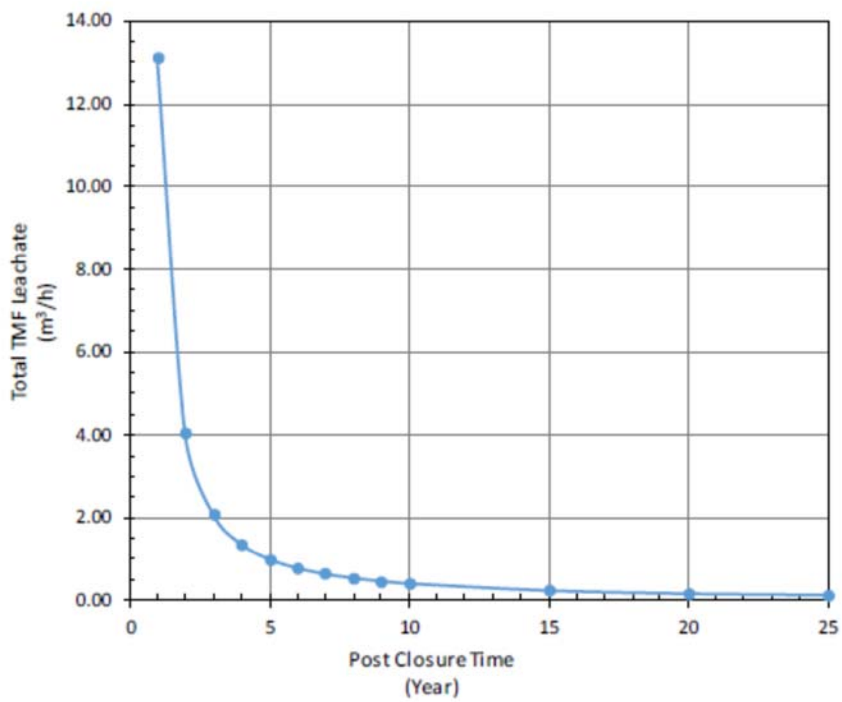
The spreadsheet cost estimates for post-closure water treatment are approximately $1 million for capital investment, and $2.6 million for 10 years of operation. Unfortunately, there is no way to predict that treatment can be terminated after 10 years; 10 years is at best a guestimate.

- In order to protect the public, the financial surety should cover treatment in perpetuity. Then, when flow actually stabilizes, the amount can be adjusted and monies returned to the company.

03-2. RESPONSE

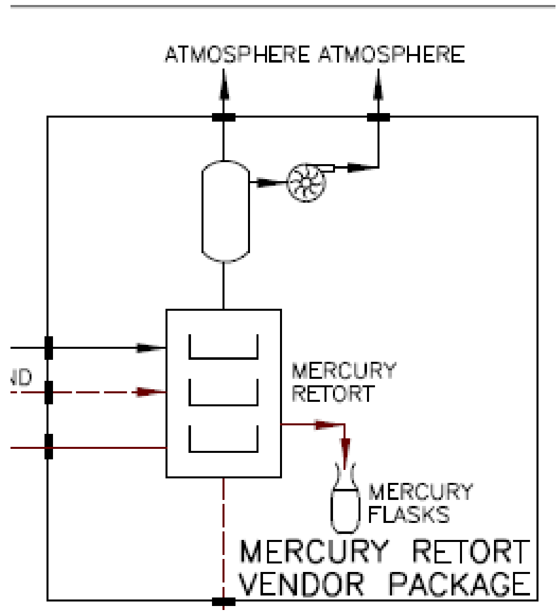
The $2.6M allowance for postclosure water treatment was based on the water treatment unit cost in the project cost model and conservatively addresses the treatment costs for average annual postclosure TMF seepage rates predicted in Section 11.4.2 in Appendix C of the MPAA. The costs to treat the final major flux of water during the first year of Phase 3 reclamation is estimated to be $422,000. As seepage subsides in Year 2 and Year 3 of Phase 3 reclamation, the annual water treatment costs decrease to $140,000 and $56,000, respectively. In summary, the $2.6 allowance for postclosure water treatment in the financial assurance cost estimate for the LOM operation period accounts for the treatment of the final major flux of water from the TMF and CWB at the onset of Phase 3 of reclamation and 25 years of postclosure water treatment. This includes operation of the Closure WWTP following decommissioning of the Operations WWTP.

:over installation.



Graph 4: TMF Total Post-Closure Leachate Generation Rate with Time

04. Mercury (Hg) emissions



Mercury (Hg) will be emitted in dust particles and as gaseous emissions from the processing plant. Hg in dust emissions from material handling and wind erosion were accounted for in the air deposition model. In the air permit, Aquila states that they do not come under the EPA 40 CFR Part 63 EEEEEEE regulations for Hg emissions from gold mines, in that they are primarily a copper-zinc mine, not a gold mine. This remains true with the MPAA, where the majority of material is flotation ore (7,759 kt) that produces copper and zinc, not oxide ore (1,837 kt) that produces gold and silver. However, this does not mean emissions from the processing plant should be ignored.

There is no easily accessible information on the percent of Hg in the ore. **MPA Section 5.4** (Geochemical characterization) notes that Hg can leach from waste rock and tailings, but does not mention content in ore. Nor did **Section 5.5.2 of the MPA** (Mineralogy).

04. RESPONSE
The material composition (including mercury) of material types handled on site can be found in the Michigan Air Use Permit – Permit to Install Modification (Foth, 2018), Appendix C. Refer to page 5 of this appendix. The ore composition values used in the emissions calculations are very conservative, based on a statistical evaluation of a large body of exploration data. Further description can be found in the original Michigan Air Use Permit – Permit to Install (Foth, 2015), Appendix H. The values used in the current application are the 95 percentile of the data distribution for that constituent. Oxide ores were included in the data set are therefore represented in the composite ore composition. Oxide ores may have higher levels of a constituent than the sulfide ore and vice versa, however, the single set of values represent all ore types. This provides a conservative estimating basis.

04-1. Mercury retort

Figure 4-11 of the MPAA, as well as text, state that all oxide ore will go through the mercury retort, which will have two mercury products – gaseous emissions to the atmosphere, and "captured and condensed" emissions sent to mercury flasks. There is no detail.

- What is the percent Hg in the oxide ore?
- Given that, how much is estimated to be captured in Hg flasks?

- At other mines, gases from the retort may be passed through sulfur-impregnated carbon columns to capture residual Hg. Will this happen at Back Forty? Will the carbon columns be shipped off- site with the Hg flasks? Has the frequency of replacing carbon columns been estimated and calculated in costs?
- Will Hg emissions also be released at the furnace?
- How much total Hg is estimated to be released to the atmosphere?
- How will emissions be measured at the stack, and how frequently?
- What are the "three stages of Hg removal" referred to in **MPAA Section 4.4.1**?

  "mercury from the filter cake will vaporize and the off-gas will condense into one of three stages of Hg removal before the gas is exhausted to the atmosphere".

- What steps will be taken to protect human health for workers in areas of the processing plant where there is Hg vaporizing and off-gassing?

04-1a. Response

The mercury retort and refining furnace proposed for the Project are discussed in the Michigan Air Use Permit – Permit to Install Modification (Foth, 2018). A general discussion is provided in Sections 3.3 and 5, with equipment further detailed in Appendices A-9 and A-10. Details on mercury emissions and generation of liquid mercury have been provided in Appendix C Emissions Calculations, page 28. As required in the permit application, a malfunction abatement plan (MAP) is included as Appendix E. The MAP addresses preventative maintenance and inspections of air pollution control equipment. Permit to Install 205-15 and the anticipated amended permit contain design and operating conditions on the equipment and operation parameters of EUHGRETORT and EUREFINEFURNACE, the emissions unit codes assigned to the mercury retort and refining furnace respectively. Mercury retorts are routinely part of precious metal processing. The technology is mature and effective and several manufacturers sell this equipment. The retort system proposed for the Project is a smaller capacity system relative to systems commonly sold commercially.

Ore Composition

Ore composition is addressed in response 04.

Mercury Capture in Flasks

The amount of mercury captured will vary with the ore being processed, however, this being a small batch processor; Aquila is anticipating mercury generation of less than 75 liter per year.

Waste Disposal

Mercury and spent pollution control media will be managed and disposed in accordance with all applicable regulations and industry best practices. Costs for disposal of all wastes have been incorporated into the economic evaluation of the Project.

Mercury Emissions

Emissions from the retort system are described in Appendix C, page 28. Mercury emissions from the system are in two compositions: as a mineralogical component to particulate matter emissions; and as elemental vapor exiting the stack. The first composition is estimated at 8.6 x 10-2 pounds per year as part of PM. Elemental mercury vapor is anticipated to be 10-4 to 10-5 grains per cubic foot exhaust. Equipment installation, commissioning, and operations and maintenance manuals will provide details on methodologies and equipment proving. Emissions measurements and operational parameters are /will be detailed in the Permit to Install.

Mercury Removal Stages

The three stages of mercury removal are described in Foth (2018) Section 5.2.5.1. The first two stages consist of water-cooled heat exchangers that condense mercury vapor. The third stage consists of a sulfur impregnated carbon bed that removes remaining mercury from the exhaust.

Health and Safety

As with the entire facility, the mercury management, processing, and transport will be conducted according to applicable OSHA, MSHA, and environmental requirements. The intent of those multiple agency regulations address worker safety, public safety, and environmental protection.

A Hg management plan that addresses these questions should be developed as part of the **EIAA**. It should include detail on the retort, such as this section in the Donlin mine Final EIS:

> *The retort removes moisture and mercury from the material by elevating the temperature and air sweeping the chamber. The vent gas from the retort is processed in two stages of mercury abatement equipment: condenser and carbon bed. The condenser vessel is an indirect shell-and- tube heat exchanger that reduces the gas temperature and condenses elemental mercury. Mercury is collected at the bottom of the condenser and drained into a storage flask for disposal. The vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for final mercury removal after the liquid mercury has been removed.*

MPAA Section 4.4.4 says the description to prevent release of contaminants in the MPA remains valid; however, the MPA did not mention Hg flasks or off-site transport of Hg, therefore Section 4.4.4 remains incomplete. Similarly **Section 5** remains incomplete in that it does not address captured Hg as mine- related material.

Aquila disagrees. As described above, mercury wastes and all mine wastes will be managed in accordance with the application, regulations, and permits issued to the Project.

In the **air deposition modeling** (Foth 2018), it does not appear that emissions from the retort were accounted for**. Attachment 1** "Deposition Inputs" uses shorthand codes for emission sources, so it is not possible to be certain if the retort was included, but "area sources" in Attachment 1 include only the pit, wind erosion, and material handling at the TMF and waste rock piles. It also does not appear that fugitive Hg gaseous emissions from the tailings pond was accounted for, and it is unclear whether Hg in fugitive dust from the tailings beach was accounted for.

- About 10% more oxide ore will be processed, according to the MPAA, than was expected in the MPA. An estimate of the amount of Hg expected to be emitted to air, along with the form and fate of the Hg should be provided given the MPAA estimate of processing more oxide ore.

- Clarify whether fugitive Hg emissions from the tailings area (gaseous emissions from pond, dust from beaches) were accounted for in air deposition modeling.

04-1b. Response

Deposition Modeling - Mercury Retort Emissions Inclusion

Mercury retort emissions are described in response 04-1a. In the context of deposition, the PM emissions take place indoors, will not be exhausted significantly to the atmosphere, and therefore will not be a deposition source.

The stack exhausts elemental mercury vapor at 10-4 grains per cubic foot exhaust. Data below are listed in Appendix C, page 28. Converting to grams per second:

1 x 10-4 grain/ft3 x 1 gram/15.43 grain x 50 ft3/hr exhaust = 9 x 10-8 g/sec.

According to the Mercury Report, (USEPA, 1997), only a very small portion of elemental mercury emissions deposit in the locality close to the emissions source. The value used in this evaluation is 2% of mercury vapor will deposit. Applied to the stack exhaust estimate, this leads to the conclusion that the retort exhaust is not a significant contributor to mercury deposition and it therefore was not included.

Fugitive Mercury Gaseous Emissions from the Tailings Pond

Aquila is not anticipating gaseous mercury emissions from the tailings pond.

Mercury in Fugitive Dust from the Tailings Beach

Fugitive dust emissions from the tailings beach are accounted for in the area source input labeled "TMF-WIND".

Oxide Ore Processing Rate

The emissions calculations provided in Appendix C of Foth (2018) and the deposition evaluation (Foth, 2018) are based on the ore processing and facility operations described in the MPAA (Foth, 2018).

04-2. Mercury storage and transport

In the **MPAA**, it is stated that Hg captured from the retort will be shipped off-site. Further details are needed. To date, there is very little market for such by-product mercury, exporting it is illegal, and there is no storage site. A site in Nevada has been developed for military waste mercury, but it does not allow civilian mercury. A site in Texas has been proposed as a repository for this type of civilian mercury, but it has not been built. Nevada gold mines appear to keep their captured mercury on-suite. Nevada has guidelines for handling Hg that could be adopted by regulators as a requirement for the Back Forty.

- Details on handling Hg flasks and carbon columns is needed.
- Details on storing Hg flasks and carbon columns for transport off-site is needed.
- Details on packaging Hg flasks and carbon columns for transport off-site is needed.
- Details on the method and frequency of off-site transport of Hg is needed
- Importantly, detail on a final destination for the Hg is needed. To our knowledge, there is no market for byproduct Hg in the US, export of byproduct Hg is banned, and there is, as yet, no legal repository for permanent storage of byproduct Hg from gold mines.

04-2. RESPONSE
Mercury is present in a variety of industrial and consumer products. Over the last 20 years, mercury thermometers and switches have been phased out, disposed, and replaced with other technologies that do not incorporate this chemical. Mercury in small amounts continues to be present in widely available lighting products. Mercury continues to be used by certain industries as well. Recycling for both public and industrial products is encouraged and widely available. Managing mercury and other waste products from the mine operations have a variety of recycling and disposal options. Aquila will evaluate the best options and contract as appropriate. All waste management and disposal will be conducted in a safe and environmentally responsible manner and in accordance with best industry practices and federal, state, and local rules.

05. Potential hydrologic impacts to wetlands

05-1. Cut-off wall

The cut-off wall has been extended from 400m to 427m, but still does not cover a long area on the southwest side of the pit, where a wetland lies between the pit and the Menominee River.

- To prevent hydrologic connection between the wetland and pit, the cut-off wall should be extended along this section.

05-1. RESPONSE
The cut-off wall was installed in the down-gradient areas relative to the pit, based on both the groundwater contour maps and groundwater modeling. Groundwater contour maps provided with the 2015 MPA show that the wetlands immediately southwest of the pit (i.e. WL-14/14a/15b) are side-gradient relative to the pit location. In addition, wetland WL-15 is included in the direct taking acreage, and wetlands WL-14 and 14a are included in the indirect impact acreage.

05-2. Dewatering pit sumps

The **MPAA** did not mention the method for dewatering the pit, although the **EIAA Section 2.4.1** notes that pit dewatering remains “essentially unchanged from the permitted project”. Presumably they intend to dewater with in-pit sumps rather than dewatering wells, as a way to protect wetland hydrology.

However, there is no good description of the pump system in the 2015 **MPA**, including in **Section 5.8.2** “Location, size, capacity of dewatering, diversions, storage, and treatment facilities”. A description of major systems for dewatering is required by Part 632, rule 425.03. The only specifics were in the **MPAA Appendix D** “Amended Water Management Plan” (Golder 2018), which states an “open pit dewatering runoff pump rate” of 117.9 m^3/h. There is no mention of inspection in **MPAA Appendix F Table 6-1** “Monthly schedule for inspection and monitoring of min-related facilities” or **Table 6-3** “Mine pit facilities inspection plan and schedule”.

- A description of the in-pit dewatering sump system, including specifics on sump capacity, lines, power consumption, maintenance routines (e.g. checking for freezing), and contingency plans should be provided.
- Can Aquila provide examples of where in-pit sumps have been utilized for dewatering in mines?

The in-pit sump system is particularly important in the early years of mining, given that the contingency plans for extreme events with high surface runoff that fill the contact water basin are to divert water into

the pit.

05-2. RESPONSE
Details of pit dewatering will be provided during the design phase. However, at this time it is anticipated that in-pit sumps will be used for dewatering. Dewatering equipment will be included in a regular inspection and monitoring plan. In-pit sumps are a common method used to dewater pits in this setting.

06. Air deposition modeling

The Foth 2018 "**Air deposition**, water quality, and soil impact analysis" has important issues that need to be addressed.

- **Table 1** is incomplete. It should provide information on the water quality standard, the baseline (mean or median and range), and expected mean (or median) water quality post-deposition.
- **Table 2** is incomplete. A column with baseline concentrations should be provided.

Critically, Hg emissions from the retort do not appear to have been included in the deposition modeling, as described earlier in this memo.

Attachment 3 in the air deposition model report has critical, but incomplete, information. There is a critical data gap from 2009-2018.

06. RESPONSE
Table 1 is a high level summary of the water quality impact evaluation. Water Quality standard, baseline data, and expected water quality pre- and post-deposition can be found in Attachment 3. Similarly, Table 2 is a high level summary of the soil evaluation. Baseline concentrations and analysis details can be found in Attachment 4. The data gap between 2009 and 2017 is an artifact of the Project development. The two years of baseline data provided in the MPAA fulfills the requirements of the Part 632 application process. Those data are adequate to evaluate the potential impacts of deposition from the Project.

06-1. Mercury (Hg)

Sulfate and Hg appear to decline significantly over time, possibly due to changes in air quality regulations. While **Table 1 of Attachment 3** lists the Menominee River and Spring Lake as being "above water quality standards" (WQS) for Hg, in fact the Menominee River has a baseline Hg concentration of 1.5 ng/L, and is therefore just over the WQS of 1.3 ng/L; Spring Lake baseline has NOT exceeded WQS since September 2008 (Shakey station MSG3). This introduces a bias in which high concentrations in early samples skew the mean above WQS. Again, only the most recent data should be used when calculating the impacts and the "ratio" of incremental deposition on baseline. – in this case, because of an apparent decline in Hg emissions in late 2008 or early 2009.

The recent baseline Hg for sample site MSG 1 is 0.563 ng/L (June 2009) and 1.42 ng/L (July 2018); all other dates are 4 ng/L or higher. The recent baseline for sample site MSG 3 is 0.63 ng/L (June 2009) and

1.15 ng/L (July 2018). The means for these two sites would be below the WQS of 1.3 ng/L.

Importantly, air deposition modeling would increase Hg concentrations in Spring Lake water by an estimated 2 ng/L. This alone is well above WQS. When added to baseline, it takes baseline from below WQS to above (violating) WQS.

- **It is critical that only recent Hg data be utilized in determining impacts of Hg deposition to Spring Lake.** The data strongly suggests that Spring Lake meets Hg WQS, but will strongly exceed WQS due to impacts from air deposition from the mine.
- **Hg deposition could be higher than estimated.** The air deposition model did not consider the impacts of gaseous Hg emissions from the retort or the tailings pond, and possibly did not consider Hg in dust from tailings beaches. Depending on the form of Hg (e.g. reactive gaseous mercury), gaseous emissions could precipitate in the area and add to the total concentration.

06-1. RESPONSE

The baseline data might appear to show that mercury and sulfate concentrations are decreasing over time, although with relatively few data, the trend may not be substantive. The two years of baseline data between 2007 and 2009 show routine exceedance of mercury in the Menominee River station (MSG-13) and the two stations to represent Spring Lake (MSG-1 and MSG-3). After a gap of 9 years, one data point is encouragingly low on all three stations, indicating a potential improvement in the environment as a whole. However, one can not conclude a substantial, durable reduction until additional data are collected.

The baseline concentrations used in the deposition evaluation are relevant in the estimate of potential future water quality concentrations after applying the deposition increment. Lower baseline concentrations for a parameter indicate the water body has a greater assimilative capacity to accept an increment load from the Project. Therefore, a lower baseline basis is less conservative than a higher one. The potential future concentration estimate including increment is useful as one can make a numerical comparison to the water quality standard to evaluate whether the increment causes water quality exceedance. When the parameter already exceeds the water quality standard, this approach cannot be employed. To evaluate in this situation, a subjective presentation using the ratio of increment to baseline is used. There are no guidance or standards on this ratio.

The deposition increment has been discussed in the memo. It is less an estimate than a high end bracket due to several layers of conservative assumptions. These assumptions include using a maximum emissions rates basis, use of conservative composition values, and neglecting to consider the long geochemical time frames during which mercury may be liberated from a mineralized form. As discussed in Responses 04 and 04-1a and b, the deposition model considered gaseous mercury emissions and PM from the tailings beaches appropriately.

In the case of mercury, another approach to evaluate the impact of the potential increment is to compare the increment to the range of comparable data, not to the lowest value of the data. Parameter concentrations likely vary with season, weather, and perhaps the trend potentially identified in the comment. The range of mercury concentrations are shown in the table below. As shown, the increment lies well within the natural variation illustrated by the data set.

Deposition Increment Comparison to Mercury Data from Three Surface Water Sampling Stations

Sample Date:	MSG-13 Mercury (ng/L)	MSG-1 Mercury (ng/L)	MSG-3 Mercury (ng/L)
9/07	10.6	10.2	8.11
12/07	3.64	3.88	2.35
12/07	3.43		
3/08	3.38	2.91	11.5
7/08	7.55	7.31	11.1
7/08	5.77		
9/08	5.28	5.45	3.61
9/08	5.39		
12/08	3.82	3.92	1.11
12/08	3.5		
3/09	5.86	4.32	8.44
3/09	5.14		
6/09	2.32	0.563	0.63
7/18	1.53	1.42	1.15
Range:	9.07	9.637	10.87
Increment:	0.022	1.74	1.74

Note: MSG-1 and MSG-3 were combined to derive the increment representing Spring Lake; MSG-13 is the station adjacent to the facility on the Menominee River.

Prepared by AKM

06-2. Copper, Lead, and Zinc (Cu, Pb, Zn)

Cu and Pb are measured as 1 ug/L every year until 2018, suggesting the method detection limit (MDL) became more stringent in 2018. It is very important to know whether Cu and Pb were actually measured as 1 ug/L, or whether they were simply below the MDL. Similarly Zn was 10 or 50 ug/L until 2018, when it was measured at 4.8 ug/L. If the "mean" includes 2007-2009 data with MDL's too high to accurately detect Cu, Pb, and Zn then the impacts to water quality from air deposition of these contaminants could be significantly understated.

- If Cu, Pb and Zn were below the MDL from 2007-2009, then **only** the 2018 data should be used in determining the "ratio" of incremental deposition to baseline.

While the incremental addition would increase (e.g. Menominee River air deposition for Pb would be a 2.5% increase and for Zn it would become a 6% increase) these are not important, as they remain well within WQS.

Lastly

- Consideration should be given to adding arsenic to the air deposition model.

06-2. RESPONSE
As discussed in Response 06-1, a higher baseline is more conservative to this evaluation in the more important water quality standard comparison. Copper, lead, and zinc are parameters that the stations under consideration meet the water quality standards in baseline conditions. Use of the MDL at the time provides a more conservative evaluation than adjusting it to lessor concentrations. Arsenic was not included in the deposition analysis due to its low emissions. Arsenic is not particularly prominent in the ore and waste rock. Annual emissions are estimated at 34 pounds; a relatively low value compared to those constituents chosen for the evaluation.

07. Pit closure

The MPAA should by now have a description of the pit closure low-permeability cover. While it is understandable that the specifics of limestone amendment may need to wait until there is more accurate data on waste rock chemistry, there is no reason to wait on the design of a cover. From **MPAA Section 5.6**:

> *Prior to Mine Year 6, Aquila will provide to MDEQ a detailed backfilling plan for final approval, per MP 01 2016 Special Condition O2 that will be designed to maintain long-term compliance and will address the following:… Description of limestone amendment process and engineering specifications of the low permeability cover system*

To date, the descriptions of the cover strongly suggest highly permeable material, such as overburden, with no details of low-permeability material, such as geotextile or clay.

- Provide a detailed design for the low-permeability pit closure cover in the MPAA.

As there have been no design changes to pit closure, our previous concerns regarding Pit Backfill plans remain. These were provided in a February 24 2016 memo from CSP2 to Save the Wild UP and the section on Pit Backfill is incorporated here by reference. Specifically, there are concerns about contaminant mobilization from the pit at closure, including potential underestimation of the concentration of contaminants and overestimation of groundwater dilution of contaminant concentrations en route to the Menominee River.

07. RESPONSE
The closure plan for the mine pit includes amending the waste rock with limestone, placement of a low permeability cover over the waste rock and then placement of overburden material over the low permeability cover. The cap over the waste rock will not be constructed of “highly permeable material”. Prior to closure Aquila will submit to the MDEQ a final closure plan based on updated geochemical modeling, and other date related to the pit, that will address procedures for amending the waste rock with limestone, placement of the material back into the pit, and design details for the low permeability cover. In addition, the final closure plan will contain updated analysis demonstrating protection of Menominee River based on closure plan details which, as stated, will include final design details for the low permeability cover. As stated in the Part 632 contested case hearing there are a number of options available to Aquila for construction of the low permeability cover including the use of GCLs and clay purchased from a local borrow area. The issue of contaminant mobilization was addressed in the Part 632 Contested Case Hearing.

08. Environmental monitoring

08-1. Monitoring requirements

There is a note on **Table 2 of Appendix F** of the MPAA that fish tissue monitoring, currently scheduled for once every three years (triennially) during operations and post-closure, that “requests can be made to reduce the frequency of this monitoring”.

- Why is this the only monitoring that suggests frequency could be reduced?
- If a request is made to reduce the frequency of fish tissue monitoring, will the request go through a public notice process?

There are several rows that do not specify the frequency of monitoring.

- Post-closure monitoring is both a column in Table 2 and a row. Please clarify if the row “Post- Closure” refers to different media monitoring than is already listed in the column.
- For “Operations Water Montioring” (sic), we are referred to the NPDES permit. Table 1 notes the NPDES permit was issued in April 2017. Please take the monitoring requirement information from the NPDES and put it in **Table 2 of Appendix F** of the MPAA.
- For Mine Facilities inspections, we are referred to the “applicable permit”. Please state what this permit is (or these permits are). If they have been issued, please transfer the monitoring frequency requirements to Table 2.

08-1. RESPONSE
Mining Permit 01 2016 Special Condition states monitoring frequency reductions can be requested. This option is offered by MDEQ at its discretion. The process to review and approve a monitoring reduction is administered by MDEQ. Table 2 is a high level summary table. The left hand column lists the modules in the EMP, with monitoring frequencies shown in the table where appropriate. The last entry for Module 7 Postclosure Monitoring has multiple variables, too many to summarize in this table, therefore the entry was intended to direct the reader to the module for additional detail. The NPDES monitoring requirements can be found in to Module 5 for Operations Water Monitoring. The Mine facilities inspections will be updated upon issuance of applicable permits.

08-2. Surface water monitoring

Surface water is currently scheduled for analysis of nitrogen species, phosphorous, and total suspended solids (**MPAA Appendix F Table 4-4**). However, air deposition analysis was conducted for Cu, Hg, Pb, and Zn suggesting these are expected to be potential contaminants that may enter soil and water. While the estimated changes to baseline were (in some cases potentially erroneously) minimal, the only way to verify the model is to measure metal concentrations in soil and water. Surface water is the only medium with such limited sampling. Sediment is to be monitored for arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), Cu, iron (Fe), Pb, lithium (Li), Hg, nickel (Ni), selenium (Se), silver (Ag), Zn (**Appendix F Table 4-5**), contact water will be sampled for these and antimony (Sb), cyanide (CN) , and major ions (**Appendix F Section 5, Section 2.2**), while WWTP discharge includes most of these and molybdenum (Mo), boron (B), cobalt (Co), strontium (Sr), thorium (Th), and vanadium (V). Some of these, such as WWTP discharge, are sampled weekly, therefore adding a suite of metals to quarterly surface water monitoring should not be a financial burden.

- **Surface water must be analyzed for total metals.** Where total metals exceed water quality standards, or where there are significant changes from baseline, dissolved concentrations of those metals should be added to the analysis. “Significant” should be clearly defined by regulators, e.g. 2 standard deviations above the mean, or within 10% of the upper baseline range, etc.
- Surface water should be monitored for the same metals monitored in sediment.

Surface water flow/stage is scheduled for quarterly monitoring. Staff gauges will be installed in several locations (**MPAA Appendix F, Section 2, Section 3.1**). However, there appears to be an intention to avoid sampling the full range of flows – although the wording in **Section 3.2** is confusing:

> *will not be collected at stream/river locations when the flow at the time of sampling is at or below the 95% exceedance flow (stagnant), compared to baseline conditions*

Some analytes, such as calcium, are highest during low flow when the inputs are primarily from groundwater, while others, such as metals and suspended solids, are highest during high flow. The concentration x flow is the calculation for the mass loading to the system, and is an important component of understanding potential changes that aquatic life experiences.

- As the equipment for monitoring flow is in streams and rivers, there should be no additional burden to monitoring monthly. At a minimum, monitoring should capture the range of low and high flows. Some of this could potentially be done with automated systems.
- At the very least, there is no reason to wait a full quarter to sample, if flows are out of an acceptable range on the scheduled sample date. Rather, sampling should occur as soon as flows are approximated to be within the acceptable range.

A statement in **Appendix F Section 7.0** suggests that the natural variations in flow with seasons will be normalized (a similar statement is made for groundwater monitoring):

> *"sources of variation in data unrelated to site activities such as seasonality will be statistically estimated and controlled"*

- Please explain the statement above. Aquatic species will feel the combined impacts of activities on and off-site, and regulators should be cautious of statistical methods that attempt to remove the effect of off-site inputs to water quality. Instead, it would be better to keep the data and compare upstream and downstream results for flow and concentrations.

08-2. RESPONSE
Surface water stations and aquatic monitoring stations have been established for the site over the last decade. MP 01 2016 represents a significant review of baseline conditions and MDEQ specifically added parameters to various monitoring stations. Surface water stations and parameters are extensive as shown in Module 2. The parameters presented in Module 4 at the aquatics stations supplement the large data set addressed in Module 2. The program and guidance received from MDEQ are standard practice as is the quarterly monitoring frequency. The text excerpted from Module 2, Section 3.1 is directly from MP 01 2016, Special Condition K4e.

08-3. Biological monitoring

While many types of biota will be sampled to determine community composition, the only tissue sampling will be for fish. Fish tissue will be tested for Se and Hg, which is appropriate. It is important that mussel tissue also be added to monitoring, and that baseline for mussel tissue contaminants (metals) be determined prior to mining. The analyte list for mussels should be slightly larger than that for fish; shellfish, as bottom filter-feeders, are particularly prone to accumulate some contaminants, such as arsenic.

- Add mussel tissue to biological monitoring, perhaps triennially with fish tissue.
- The same species must be tested in all locations to the extent possible.
- Perform baseline tissue analysis for metals in mussels, including but not necessarily limited to As, Cu, Pb, Hg, and Se.

Whole Effluent Toxicity (WET) testing is planned, but no details are provided (**MPAA Appendix F, Section 5, Section 3.3**). These are standard tests and it should not be difficult to obtain testing protocols.

- Provide WET test details in the MPAA.

08-3. RESPONSE
Aquatic biota types for tissue testing have been outlined by MDEQ under the guidance of professional, credentialed biologists. WET testing is a routine test conducted by numerous permittees throughout the nation using commercial laboratories. WET test procedures will be developed in accordance with all applicable requirements following industry practice and MDEQ guidance.

09. Groundwater model

The **EIAA Appendix A** provides an update on measured groundwater hydraulic conductivity (K). While the updated 2016 measurements of K for fresh bedrock appear to be similar to the older measurements that the groundwater model is based on, it is disturbing that K for weathered bedrock and Cambrian sandstone are on average four to ten times faster than the model utilizes – yet the EIAA states the groundwater model remains valid because the newer measurements remain “in the previously measured range”. This is a specious argument in that the previously measured range is huge (e.g. 0.003 to 1.8 m/d). Additionally, it would be useful to know if the medians of updated (and previously measured) flows are similar to the means of updated (and previously measured) flows, and if not, whether it is high K outliers or low K outliers that shift the mean.

- The groundwater model should be re-run with the updated measurements, with particular focus on how faster K changes the volume of water that would need to be dewatered, and associated impacts on a) wetland hydrology and drying and b) flows into the WWTP.

- Will the updated K, if applied to the groundwater model, change the current water balance (EIAA Appendix B)?

09. RESPONSE
As stated in the permit amendment application, the groundwater model calibration remains valid for the units modeled, including the Cambrian Sandstone and Precambrian Fresh Bedrock. In the Cambrian Sandstone, the updated 2016 hydraulic conductivity (K) geometric mean value of 0.87 meters per day (m/d) is closer to the model-calibrated K value of 1.6 m/d than the previously measured geometric mean K value (0.08 m/d). In the Precambrian Weathered Bedrock, the updated 2016 geometric mean K value of 0.026 m/d is again closer to the model-calibrated K value of 0.47 m/d than the previously measured P50 K value (0.0069 m/d). In both cases, the model-calibrated K value is higher than the measured value, leading to a conservative model prediction for both wetland impacts (model predicts larger radius of influence) and pit in-flow (model predicts higher in-flow rate). With respect to the water balance, the higher K used in the groundwater model leads to an over-prediction of water volume removed from the aquifer.

10. Alternatives analysis

In the **EIAA Table 5-1**, Alternative B (off-site processing) is rejected as more expensive, although it would substantially reduce the footprint and aquatic impacts at the Back Forty site. It would also eliminate the need for a post-closure WWTP at this site, which, as mentioned previously, may need to operate in-perpetuity to treat TMF seepage. While processing off-site would not necessarily eliminate the need for long-term post-closure water treatment (although potentially it could), it could at least place a long-term facility in a site that poses less risk if/when there is a failure. This should be a consideration in the Alternatives Analysis.

- An actual cost spreadsheet that evaluates the costs of refurbishing old existing plants must be provided as a comparison to the cost of building a new plant. Differences in associated costs – such as savings in liners and covers if tailings could be stored in pits or tunnels at a different site, additional potential costs for public road maintenance due to damage from ore trucks, any differences in costs related to a post-closure WWTP, and differences in the cost of transporting chemical reagents should be provided.
- Only the impacts to aquatic resources are provided in the Alternatives comparison. What about impacts to other resources, such as human health, cultural resources, and so forth?

10. RESPONSE
The scope of Alternatives Analysis provided in the EIA are outlined in Michigan Rule R 425.202(1)(c). In summary, the analysis should cover feasible and prudent alternatives to the Project configuration, including a description of those alternatives considered and discussion of why the chosen alternative is preferred. The analysis is not formulaic; it is tailored to the project being evaluated and to the priorities and judgement of the applicant. The terms feasible and prudent are somewhat subjective. Alternatives proposed by others may or may not be feasible or prudent in the opinion of the preparer. The Alternatives Analysis details are provided in the EIAA (Foth, 2018) and meet the intent of the rule requirement for the application.

11. Annual reports

In the **MPAA Section 1** (groundwater monitoring) and **Section 2** (surface water monitoring), language should specify that annual reports will provide easily readable graphs, including trends in contaminant concentrations and contaminant concentrations relative to air, water, soil, and biota tissue baselines.

Narrative summaries should clearly address changes observed and the linked changes in risks to water quality, soil quality, fisheries, wetlands, or other resources. For surface water, comparisons of upstream and downstream data should be provided in a clearly understandable manner.

11. RESPONSE
Aquila's annual report will present data from the Project's Groundwater and Surface Water Monitoring Programs. Aquila will be providing this data in formats that are in readable graphical formats as suggested by these reviewers. Aquila will also be providing narrative summaries of the data as requested.

12. Inconsistencies

12-1. Ore volumes

In the MPA, 10.8 million tonnes of flotation ore would produce 106 kt of Cu concentrate and 22 kt of Pb concentrate. In the MPAA, only 7.8 million tonnes of flotation ore would be processed, about 25% less than in the MPA, with 140 kt of Cu and 31 kt of Pb concentrate produced. Have they revised the estimates of ore quality?

- How is it that much less flotation ore will be processed yet more Cu and Pb produced?

The apparent amount of dore has been revised greatly, despite only about 10% more oxide ore expected to be processed. The MPA lists the amount of Au + Ag dore as 1,384 k oz, from processing 1,653 kt of oxide ore. The MPAA lists the amount of Au+Ag dore produced as 12,124 k oz from 1,837 kt of oxide ore.

- How is this possible?

There is a mistake in **Section 4.1** where the MPAA states that the oxide plant will process 4,000 tpd of oxide ore, and 800 tpd of flotation ore. In **Table 4-1** of the MPAA and from the Golder report of October 2018 attached to the MPAA, it appears that much more flotation ore (7.76 Mt in Golder) will be processed than oxide (0.29 Mt in Golder). Please clarify or correct the Section 4.1 table. **From MPA**: Flotation ore at 4,236 tpd and oxide at 647 tpd. **From MPAA**: In the column for the MPA, this is reversed, saying 4,236 for oxide and comparing it to new plan of 4,000 oxide/800 sulfide.

12-1. RESPONSE
Regarding total ore quantities, **Table 4-1** Mining and Milling Production Schedule in the MPAA is consistent with the attached Golder report <u>Tailings Management Facility, Waste Rock Facilities, Ore Storage Areas and Overburden Stockpile</u> (Golder, 2018) Questions requiring detailed and accurate concentrate production and ore quantities should reference the <u>BACK FORTY PROJECT, MICHIGAN, USA – FEASIBILITY STUDY NI 43-101 TECHNICAL REPORT</u> (Lycopodium, 2018). Also consider that throughout LOM, the actual production schedule will vary due to several factors such as market conditions, operational conditions, climatic conditions, etc.

12-2. Chemical reagent consumption

<u>Lime silo storage</u>

The **MPAA Section 4.4.3** notes that lime will be stored in a silo that will hold 50 tons, and be refilled weekly. This would suggest lime consumption of 2,600 tpy. However**,** **MPAATable 4-4** estimates that 56,000 tpy will be used, and the previous **2015 MPA** estimated 1.5 million tpy for the oxide plant and 13,275 tpy for the flotation plant. This suggests a potentially serious underestimation of the area needed for reagent storage.

- Clarify the lime storage needs in a manner consistent with the estimated annual usage.

<u>Mill</u>

A comparison of the **MPA Table 5-6** and **MPAATable 4-4** “Mill Reagents List” finds that virtually every reagent has been increased by 200% to over 4000% (2 to 40 times the original estimation) – despite the lower volume of ore the MPAA estimates will be processed.

- This vast increase in reagents with lower ore volume processing needs to be explained.

The only chemical reagent that has an apparent decrease is hydrated lime. In the MPA, the flotation circuit was expected to use 13,275 tpy of lime, and the oxide circuit 1,500,000 tpy. However, this is certainly a mistake in calculation. The flotation circuit would consume 8,850 g/t of lime (and process over 10,000 tpy of ore through the flotation circuit) while the oxide circuit would consume 5,000 g/t of lime (and process less than 2,000 tpy of ore through the oxide circuit); with less consumption per ton and fewer tons processed, the annual lime consumption in the oxide circuit would be *lower* than the flotation. The actual number is more likely to be 1,500 tpy, not 1,500,000 tpy.

- **Clarify whether there has been an error in the estimated lime consumption, either in the original MPA or the updated MPAA.**

If the actual lime consumption in the oxide circuit of the MPA is 1,500 tpy, then a comparison of the two charts shows the following changes in reagents (changes greater than 1,000 percent are in bold).

Reagent	MPAA (tpy)	MPA (tpy)	Change from MPA
lime - flotation	56,456	13,275	382%
lime - oxide		1,500	
AP3418A	587	152	386%
MIBC	594	194	306%
SIPX	297	135	220%
NaCN - flotation	38	38	100%
NaCN - oxide	1,955	166	**1178%**
$ZnSO_4$	1,557	113	**1378%**
Cu5SO4	3,076	1,350	228%
AN926 - flot	948	38	**1931%**
AN926 - ox		11.1	
$PbNO_4$	73	30	243%
Zn dust	293	75	391%
SMBS	3,854	90	**4282%**
Silica	68	63	108%

12-2. RESPONSE
The reagents and their usages will ultimately be dictated by the mill design and operations. Variations can be produced by the different instances of testwork, planned production throughput, head ore grades, etc. Reagents and usages are a critical part of the project design, operations, and economics. Within the permit conditions, Aquila and its mill designer will determine and optimize reagent use, management, and requirements throughout basic and detailed engineering.

12-3. Wastewater Treatment Plant (WWTP)

In a prior document, Aquila stated they would have details of a WWTP by December 31, 2018. However, a review of the **MPAA and EIAA** provided no details of this plant, and yet another indicator of delay in the statement:

> *A Part 41 Waste Water Construction Permit will be applied for construction of the new wastewater treatment plant (WWTP).* MPAA Vol I, Sec 1.3

- **The specific processes for treatment as well as the types of chemical reagents and volumes should be well-researched by now and should be provided in the MPAA.**

The lack of a specific WWTP plan has consequences for the water management plan (the physical capacity to pump water through, as well as the amount of water entrained in sludge), mine start up and closure costs, and the area potentially required for sludge storage. None of these can be addressed, nor can the efficacy of the proposed treatment be commented on, until details of the WWTP are made available.

There is also inconsistency in the potential volume of water that will pass through the WWTP. In the MPAA Appendix D "Amended Water Management Plan" (Golder, Oct 2018), the pump rate from the CWB to the WWTP is to be 283.7 m^3/h, with a pump rate from the WWTP to the River of 221 m^3/h.

- How can the rate of water coming into the WWTP be quite significantly different from the rate leaving? The rates can only be different if the amount of time of pumping is much more from the WWTP to the river on a daily basis; however, the estimates were also provided as gallons per day (gpd), with 1.8 million gpd entering the WWTP and only 1.4 million gpd leaving. Please explain this, particularly in light of the **EIAA Appendix B** estimate of equal amounts of water entering and leaving.

In **EIAA Appendix B, Table 2 and Figure 5**, 150 m^3/h enters the WWTP and 148 m^3/h discharges (2 m^3/h of water remains entrained in sludge). First, it makes more sense that similar amounts would enter and discharge. Second, there is a serious inconsistency between a discharge of 148 m^3/h and 221 m^3/h. Third, the volume of water that is treated correlates with the volume of residual sludge generated that must be disposed of. All the water that enters the WWTP comes from the CWB. The description of inputs to the CWB (59 m^3/h pit groundwater pumping, 51 m^3/h from Shakey watershed, 40 m^3/h disturbed area water) sum to the 150 m^3/h estimate, not 283.7 m^3/h.

- There are vastly different estimates of the volumes of water that will enter the WWTP. These need to be reconciled.
- In the **MPA,** sludge was expected to be put through a filter press to remove water, then the filter cakes trucked off site. A cost estimate for this proposal needs to be provided.

The **MPAA Section 6.2** states that the operations WWTP will be taken down at the end of mine life, and a post-closure WWTP will be built. There are no specifics for either.

- Why remove one WWTP and build a different one?
- How would the post-closure WWTP differ from the operations WWTP? What will be the chemical reagent consumption for the post-closure WWTP? Where will post-closure WWTP sludge be stored?

12-3. RESPONSE
Regarding the provision of WWTP details: • *WWTP information was provided in the 2015 MPA and the 2015 NPDES Permit Application.* • *The WWTP is/will be designed to achieve the treated effluent quality requirements established in NPDES Permit No. MI0059945 and the maximum discharge capacity has not changed from that established in the NPDES Permit.* • *The WWTP has been incorporated into the water management plan and site wide water balance.* • *Further details of WWTP design will be submitted to MDEQ for approval in accordance with MP 01 2016 SPC H3.* *Regarding pumping rates:* • *The difference between the pumping rate from the CWB to the WWTP (283.7 m^3/h) and the WWTP to the Menominee River (221 m^3/h) is the removal of filter backwash and sludge.* • *The difference between the pumping rates presented in MPAA Appendix D "Amended Water Management Plan" and the pumping rates presented in EIAA Appendix B, is that the EIAA presents nominal pumping rates for an "average precipitation year", whereas the Amended Water Management Plan presents design pumping rates.* *Regarding sludge disposal:* • *In accordance with MP 01 2016 SPC I4, sludge from WWTP operations will be disposed in accordance with state and federal regulations.* *Regarding the closure WWTP:* • *The operations WWTP capacity is too large to efficiently operate through closure when influent pumping rates will be much lower.* • *Replacing the operations WWTP will allow for tailoring/optimizing the treatment process as effluent chemistry is better understood into operations.* • *Design, installation, permitting, and waste disposal will be addressed for the closure system at an appropriate time.*

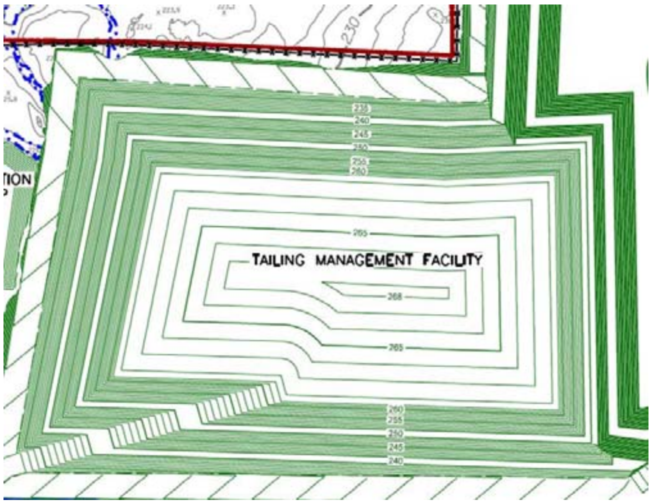
12-4. TMF design

The images of the operational TMF in the **MPAA Figure 2-2** show increasing elevation to the very top of the TMF. This would not seem to be feasible given the approximately 35% moisture content of tailings.

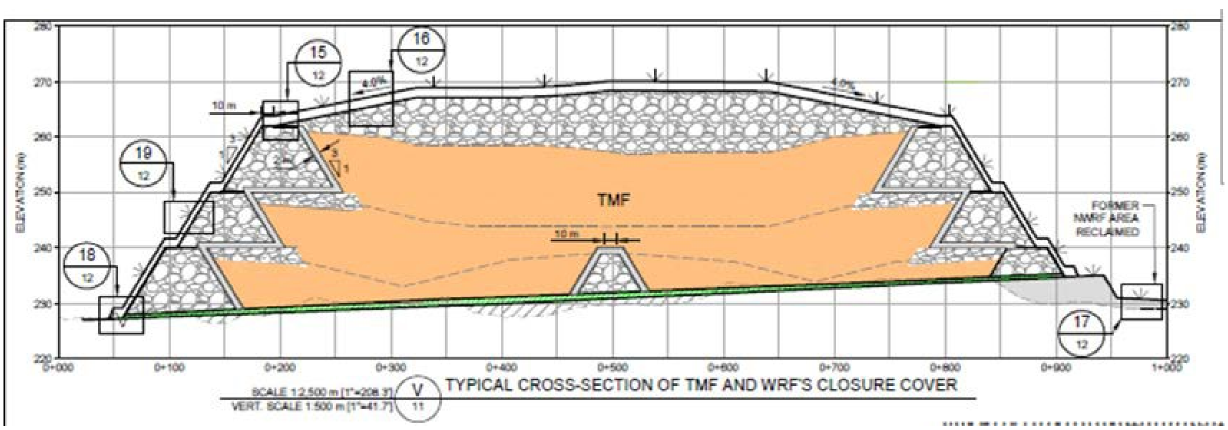
It is also inconsistent with the diagrams throughout the **Dam Safety Permit Application**, such as Golder 2018, Figure 12 shown earlier in this memo. If **Figure 2-2** shows the TMF closure design, that should be clearly stated. Additionally, there are several references to the TMF dams as "perimeter berms". These are massive structures requiring a Dam Safety Permit, and as such should be consistently designated as dams throughout the MPAA. Additionally, there appears to be an inconsistency between the **Dam Safety Application 1L**

Table 2 and the MPAA. The MPAA has the TMF at 124 acres and 138-feet high, while the dam application has the TMF as 124 acres and 118-feet high.

- TMF designs need to be consistent.



(Left) MPAA Figure 2-2 "Project site development plan". (Below) Golder 2018 Figure 12 in the Dam Safety Permit Application.



12-4. RESPONSE
Figure 2-2 of the MPAA illustrates the facility at full buildout. This depiction shows the full facility footprint, with each structure at its maximum extent. The figure is not intended to show a closure design, hence that term is not used on the figure. Figure 2-2 is also not intended to show an operational TMF. Full buildout of all structures will not occur at the same time. The TMF design with various stages, design details, and operational discussion are provided in the MPAA Appendix C. This appendix should be reviewed to address any concerns regarding the feasibility of storing tailings. Interpreting Figure 2-2 as a summary of the information in that Appendix C would be inappropriate. Responses under comment 02 above discuss the TMF design. Perimeter berms constructed from waste rock provide structure to store the dewatered tailings. The TMF is not a traditional dam, however, it is a dam according to the Michigan definition described under NREPA Part 315. A dam safety permit application has been submitted. The measurements of the structure vary depending on where one measures. For accurate design details, MPA Appendix C should be considered.