Response to Michigan Department of Environmental Quality Comments dated May 9, 2016 on the Back Forty Project Mine Permit Application

Project I.D.: 14A021

Aquila Resources Inc.
Stephenson, Michigan

June 2016

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Foth

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Prepared for

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Stephenson, Michigan

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Response to Michigan Department of Environmental Quality Comments dated May 9, 2016 on the Back Forty Project

Contents

Attachments

Mining Plan

Comment #1:
Figure 2-2, Volume I: Overall Project Timeline: When will the construction of the cutoff wall take place?

Response to Comment #1:
Construction for the cut-off wall will being in mine year -02. New Figure 1-1 provided in Attachment 1 has been revised to show the cut-off wall construction event.

Comment #2:
Sect. 5.3.4, Volume I: Additional geochemical test work will be conducted to further evaluate the amount and type of buffering material that will be added during backfilling process, which will be prepared prior to reclamation. What types of buffering material are being considered? How will the type of buffering material affect volume capacity of the pit and Tailings and Waste Rock Management Facilities (TWRMFs)? Provide a plan for ensuring pore water in the backfilled pit and leachate in the TWRMFs (including the closure TWRMF) is buffered at circumneutral pH.

Response to Comment #2:
During backfilling, additional buffering will most likely be supplied through amendment with high calcium limestone. The requisite quantity of amendment material is bounded by a number of factors. Firstly, the quantity of buffering material to be added will be in excess of the amount determined by geochemical modeling to maintain a neutral pH. Secondly, calculations of available pit and Tailings and Waste Rock Management Facility (TWRMF) volumes take into account the density of the proposed buffering material, and the volume occupied by waste materials; results verify that there is adequate space available in the designs to accommodate the necessary quantity of buffering material without design changes. The capacity calculations are described in more detail below.

Flotation and Oxide TWRMF Capacity
The current plan calls for amending the Flotation TWRMF with 30,988 tonnes (12,395 cubic meters [m^3]), and the Oxide TWRMF with 651 tonnes (260 m^3) of limestone, as described in Response to Comment #192. The volume of limestone to be added to the Flotation TWRMF, represents approximately 0.04 percent (%) of the total storage volume capacity, which includes a 5% design volume contingency. Similarly, the volume of limestone to be added to the Oxide TWRMF represents 0.01% of the total storage volume capacity, which has been designed with a 1.6% volume contingency. The addition of limestone to the Flotation and Oxide TWRMFs will not impact the design volume capacity of these facilities. The plan for amending the Flotation and Oxide TWRMFs with limestone is provided in Response to Comment #192.

Backfilled Pit Capacity
Currently, the plan for amending the backfilled pit is to add approximately 43,187 tonnes (17,275 m^3) of high calcium limestone. This volume of limestone represents 0.08% of the total storage volume capacity of the backfilled pit up to an elevation of 1 meter below the low groundwater elevation, which is insignificant compared to the total volume of material that will

be backfilled. Therefore, adding the proposed amount of limestone to the backfilled pit will not impact the backfill pit and Closure TWRMF design criteria.

Maintaining a Neutral pH

Ensuring that pore water in the backfilled pit and leachate from the TWRMFs remains neutral was the primary driver in water quality models. The plan for the backfilled pit is described here; the plan to ensure water quality for the TWRMF leachate is discussed in more detail in Response to Comment #192. In all models, the effect of adding limestone was evaluated by simulating the reaction of the modeled effluent with calcite ($CaCO_3$), the principle component of limestone (the buffering material is assumed to be 100% reactive in the model). The limestone amendment simulation was conducted in the REACT module of Geochemist's Workbench ® (Bethke, 2008), inputting results of mass balance models. The geochemical model was used to predict the evolution of pit pore water chemistry and TWRMF contact water and leachate chemistry towards equilibrium, predicting how pH and metals loading changes as limestone amendment is added and as secondary minerals precipitate. Outputs from geochemical modeling were further modified to account for limestone impurity and for any loss of reactivity due to surface area, contact effects, and/or the development of a passivating coating. High calcium limestone is assumed to have a purity of 98% $CaCO_3$ and a reactivity of 70%.

Applying these scaling factors to the predicted quantity of necessary amendment for the backfilled pit as summarized in Response to Comment #184, and using the calculated volume of pore water in the pit, then the minimum amount of limestone required to maintain saturation with respect to calcite is 482 tonnes. For practicality of implementation during operations (and taking into account available volume capacity) the current plan calls for additional conservativism to be built into the plan through application of amendment at a scaled up, convenient dosing rate during backfilling. Applying amendment at a dosing rate of 1 kilogram of limestone per tonne of waste rock during backfilling corresponds to 43,187 tonnes (17,275 m^3) of limestone, or two orders of magnitude more limestone than the model predicts necessary to achieve saturation with respect to calcite. It is worthwhile to note that further additional conservatism is present in the current plan: backfill material from the Flotation TWRMF will already have been amended with limestone to buffer leachate generated during short term storage above ground. This additional buffering material was not included in the water quality model of the backfilled pit, but some portion will likely contribute to buffering in the pit.

Backfilling of the pit will occur in approximately 1 meter lifts to achieve adequate compaction. The current backfilling procedure will be for haul trucks to dump waste rock and limestone onto sloping benches. This material will then be mixed, spread, and compacted with a dozer. Additional compaction will be achieved from haul truck tires. The amount of limestone used to amend each lift will be determined based on a dosage rate of 1 kilogram of limestone per 1 tonne of waste rock. The particle size of limestone used to amend each lift is anticipated to be similar to coarse to fine sand based on the Unified Soil Classification System.

As the project moves forward through mine construction and operations, the plan for backfilling the pit will be developed in greater detail. Aquila Resources Inc. (Aquila) will implement a plan for verifying, and refining where necessary, the requisite quantity of amendment for buffering pH in the backfilled pit. Developing the plan will require collection of data through bench scale

testing, operations water quality monitoring, and stockpile sampling. The final plan will be submitted for regulatory review and approval, and will contain the following elements:

- Column testing to investigate alkaline material amendment types and dosage rates.
- TWRMF stockpile sampling and analysis plan to obtain samples for analytical testing to determine the amount of weathering product building up on the waste material and the amount of alkaline material needed to buffer the stored acidity.
- Methods for utilizing operations leachate quality data to refine initial water quality predictions.
- Approach for determining correlation between field measurements and required amount of amendment to buffer pore water pH. The goal is to identify what measures of waste rock type or degree of weathering might be used during backfilling to determine the specific alkaline material dosage rate.
- Approach for refining methods for moving waste rock and limestone into the pit and for mixing the materials.
- Approach for optimizing limestone particle size specifications.

Reference:
Bethke, C.M., 2008. *Geochemical and Biogeochemical Reaction Modeling*, Second Edition. Cambridge University Press, Cambridge, UK.

Comment #3:
Ore segregation piles will be temporarily stored in partially covered buildings (after crushing) on a concrete pad with drainage. What is the water management plan in this part of the contact area?

Response to Comment #3:
As shown on Figure 5-10 Mine Permit Application (MPA), the covered ore segregation piles are part of the contact area watershed. Water from this area will be collected by a perimeter ditch and be directed to the Contact Water Basins (CWB) for water treatment prior to discharge.

Comment #4:
Where will "super sacks" of concentrate be temporarily stored and loaded onto trucks?

Response to Comment #4:
Super sacks will not be used for concentrate transport. Concentrate will be bulk stored in the mill and transferred to hopper transport trucks for shipment to smelters.

Comment #5:
What is the proposed water source for vehicle tire wash?

Response to Comment #5:
Vehicle tire wash will use water drawn from the CWB. The tire wash operation will be provided to remove particles from vehicle tires prior to the vehicle traveling from a contact to a non-contact area. The wash operation will have minimal flow demands and will recycle most of the water. Once washed, the tires will dry relatively quickly by drip and evaporation prior to entering the non-contact area.

Comment #6:
Clarification is needed as to what roads within the mine area are to be gravel or bituminous. It is not clear on Figures 2-1 and 2-3.

Response to Comment #6:
The main entrance road via River Road to the mine change facility during operations will be bituminous paved as shown on Figure 2-1 (MPA). All other roads will be gravel surfaced. During construction, the main entrance road will be gravel surfaced as shown on Figure 2-3 (MPA). New Figure 6-1, provided in Attachment 6, eliminates the bituminous surfaced portion during construction.

Comment #7:
What is the proposed dust suppression water source?

Response to Comment #7:
Dust suppression water will be sourced from the fresh water tank.

Comment #8:
How will the "dead storage" (sediment thickness) in the Contact Water Basins (CWBs) be measured, and subsequently removed if necessary? Since the CWBs are proposed to be monitored monthly, how will this be accomplished in winter months? The design capacity of the CWBs took into account 1.0 feet of sediment storage. The Monthly Schedule for Inspection and Monitoring of Maintenance of Mine-related Facilities (Table 5-8) includes plans to remove sediment once the thickness is 1.5-2.0 feet. Since sediment may not accumulate evenly throughout the CWBs, clarify as to what will prompt sediment removal actions.

Response to Comment #8:
Sediment thickness will be determined by deploying a small craft and a survey rod with flat base to determine depth to sediment top. A poling rod (e.g., survey rod with rebar tip) will then be pushed into the sediment until refusal. The difference of the two readings provides sediment thickness. Readings will be collected at four evenly-spaced locations in each CWB. A hand-held global positioning system unit will be used to ensure readings will be taken at consistent locations each month. Sediment accumulation rate will be assessed in the spring/summer/fall months so that sediment accumulation can be projected over the winter months. A sediment removal event will be triggered when the average of the four readings per CWB reaches the 1.5 to 2.0 foot thickness criteria. Sediment will be removed by draining the CWB and scraping with a small, rubber-tired front-end loader to either end of the pond. Sediment will then be removed using a backhoe positioned on the crest of the CWBs. During this process, an observer will be present to ensure the liner system of the CWB is not compromised.

Comment #9:
How long might material be stored on the Ore Blending Area (OBA) during operations?

Response to Comment #9:
Typically there will be a 3-day residence time of ore within the Ore Blending Area (OBA). This can fluctuate depending on mill demand.

Comment #10:
How was a thickness of 1.0 feet of reinforced concrete for the OBA determined to be adequate?

Response to Comment #10:
One foot thick concrete is deemed to be adequate based upon equipment loads. The ore haul trucks will unload at the edge of the concrete pad. Only low contact pressure track vehicles or front wheeled loaders will be allowed on the pad to segregate and feed ore to the primary crusher.

Comment #11:
Explain the design of the water collection sump for the OBA.

Response to Comment #11:
As shown on Figure 6-1 in the Treatment and Containment Plan, the concrete floor of the OBA will be sloped 1% towards a contact water collection manhole. Water collected in the manhole will be routed to the CWBs via pipeline. At the periphery of the OBA, a perimeter berm will be constructed to prevent contact water spilling outside the OBA during a significant storm event that could exceed the capacity of the OBA collection sump.

Comment #12:
All ditches conveying contact water from the ore storage area will be surfaced with bituminous concrete. Will all contact area ditches be surfaced this way?

Response to Comment #12:
As shown on Figure 3-2 from the Storm Water Management Plan, contact water ditches will be constructed with 0.6 meter thick clay barrier. It has been shown that bituminous surfaces are difficult to clean and repair. A 0.6 meter clay lined ditch will provide equal environmental protection as compared to 2-inch thick bituminous surfaced ditch and will be easier to maintain and clean.

Comment #13:
Section 5.8, Project Water Management Plan: "As necessary, fresh water will be used as make-up if sufficient reclaim water is not available. The source of fresh water will be from a potable water well(s) located on site." What is the estimated amount of fresh water expected to be needed as make-up? Is this expected to be necessary during certain times of year? Note that an RPZ (Reduced Pressure Zone) will be required on the potable water make-up line.

Response to Comment #13:
The Project water balance shown on Figure 5-14 of the MPA shows that contact water generated during the project (from precipitation on waste rock and tailings storage and handling areas, and precipitation falling on and groundwater inflow to the pit) will provide more water than that which is needed for milling and related processing needs. Excess water generated during wet periods will be stored in the CWB for later use during dry conditions. Accordingly, use of potable water for makeup water is not expected. Makeup water obtained from the potable water supply (a well) would only be used in the event of a prolonged dry period that reduced the generation and supply of contact water to the point where the CWB was empty or so low as to provide inadequate supply.

A Reduced Pressure Zone (RPZ) valve and backflow preventer will be installed in the potable water makeup line.

Comment #14:
Geochemical Investigation Report, Volume IA-IC, Appendix B, Section 3.1.3: Tailings samples preparation (bench scale testing of milling technologies) – Oxide and flotation beneficiation processes are proposed in the Mining Plan. Describe what milling technologies were applied to prepare tailings samples for kinetic testing, or specify where this information can be found in the application.

Response to Comment #14:
Tailings samples were prepared as a result of bench-scale milling technologies. The entire process from identifying the ore types and mineral processing procedures to tailings sample preparation are described in detail in the Technical Memorandum: Tailings Samples for Static and Kinetic Tests – Back Forty Project, Menominee County, Michigan. This memorandum is in Appendix A of the Geochemical Investigation Report, Volume IA-IC, Appendix B.

Comment #15:
Geochemical Investigation Report, Volume IA, Section 4.4.4: How does the calculated surface area of the kinetic samples correlate with the expected size distribution of the tailings and waste rock material to be stored in the TWRMFs?

Response to Comment #15:
The calculated surface area of waste rock contained within kinetic testing humidity cells is presented in Table 3-2 of the Geochemical Investigation Report, Volume IA. Kinetic sample surface areas ranged between 3.2 square meters (m^2) to 10.8 m^2, with an average of 5.4 m^2 per kilogram of sample. The surface area per kilogram of material was larger for material used in kinetic testing than the anticipated surface area to kilogram of waste rock for material that will be contained within the Flotation and Oxide TWRMFs. The surface area of waste rock contained within the Flotation and Oxide TWRMFs was estimated in the Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Section 4.1.2.1, using a waste rock gradation estimate based on a blast-induced fragment size distribution estimate by Orica USA Inc. The surface area of waste rock contained within the Flotation and Oxide TWRMFs was modeled as 0.02 m^2 per kilogram of waste rock.

Tailings samples for kinetic testing were obtained from bench scale testing of mill technologies. The physical properties of the tailings samples produced from bench scale testing, including size distribution and surface area, are expected to be the same as the physical properties of the tailings that will be produced during operations. Therefore, the surface area of the tailings kinetic samples were not estimated and the kinetic testing derived release rates were calculated on a mass basis for tailings.

Comment #16:
Provide a cyanide management plan.

Response to Comment #16:
As a gold producer, Aquila Resources plans to become a signatory to the Cyanide Management Code as set forth by the International Cyanide Management Institute (ICMI). The Cyanide Management Code has been widely and successfully applied in international gold projects for management of cyanide, and is recognized by the World Bank/International Finance Corporation as a best practice for management of cyanide in all mining operations where this product is used. As a signatory to the Code, the company will commit to follow the Cyanide Management Code's principles and standards of practice. Through ICMI's verification process, Aquila Resources intends to attain certification to the Cyanide Management Code. Verification of compliance will include periodic audits by qualified outside third party entities. To demonstrate compliance with the Cyanide Management Code, the company will develop a Cyanide Management Plan that outlines how it will conform to stated principles and standards of practice. The company will use ICMI's implementation guidance to develop a comprehensive Cyanide Management Plan that outlines procedures to address production, transportation, storage and use, and decommissioning of cyanide facilities as part of its operations that manage cyanide. Attachment 16 is an outline of the major elements that will be included in the comprehensive Cyanide Management Plan. For reference, a copy of the ICMI International Cyanide Management Code is also provided in Attachment 16. It outlines the principles and standards of practice that must be included in a Cyanide Management Plan. A more detailed Cyanide Management Plan will be provided prior to construction.

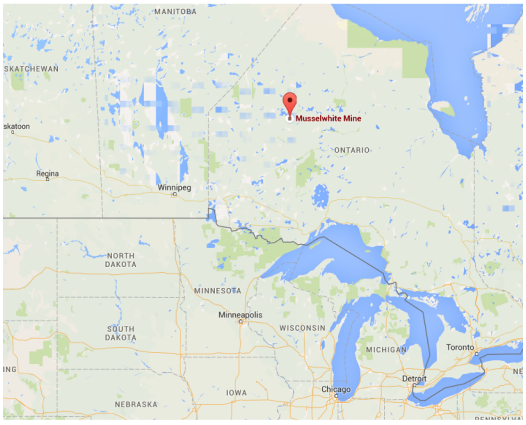
Comment #17:
Provide a design plan for the tailings pipeline, including locations of dump ponds, dump pond capacity, and how they will be lined.

Response to Comment #17:
The alignment of the tailings pipelines are shown on new Figure 17-1 in Attachment 17. As shown, there are three tailings pipeline alignments: i) the Phase 1 flotation tailings pipeline alignment, ii) the Phase 2 flotation tailings pipeline alignment, and iii) the Oxide tailings pipeline. The Phase 1 and 2 pipeline are the same pipeline at different stages of the project. A profile view (longitudinal cross section) of the three pipeline alignments are shown on Figure 17-2 in Attachment 17. The length each pipeline will range from approximately 500 to 2,000 meters. As shown, the pipelines span from the flotation and oxide thickeners to their disposal site at the flotation or oxide TWRMF. Each pipeline alignment will be equipped with a geomembrane lined dump pond at the low point of the pipeline alignment, near the thickeners as shown on Figure 17-2. The dump pond will be sized to accommodate approximately 72 m^3 of

tailings with 0.5 meter of freeboard. The maximum quantity of tailings expected to be in a single tailings pipeline at any given time is approximately 35 m^3.

Comment #18:
Demonstrate that the dewatered tailings, as proposed in the application, can be pumped during seasonally colder temperatures.

Response to Comment #18:
The wall thickness of the high density polyethylene pipe will be sufficiently thick and the flow rate of the tailings sufficiently high to withstand freezing. In addition, the thickened tailings slurry will produce sufficient wall friction in the pipeline that prevents freezing. There are several examples of projects successfully using non-segregating thickened tailings that are located in colder climates than the Back Forty site. Goldcorp Musselwhite to name one, as shown below.



Comment #19:
Figure 5-1: Explain the "Topsoil Stockpile" labelled on the Menominee River.

Response to Comment #19:
New Figure 19-1 in Attachment 19 has been revised removing the "Topsoil Stockpile" reference in the Menominee River. In addition, the 18 meter setback reference from the Menominee River

to the cut-off wall has also been removed. Further discussion regarding cut-off wall setback from the Menominee River is provided with Response to Comment #28.

Comment #20:
Provide a plan to minimize impact from surface facility lights.

Response to Comment #20:
The facility will operate 24 hours per day during mine operations. Lighting will be required from dusk to dawn. Primarily, lighting must support a safe working environment for operations personnel and be strategically placed to identify malfunctioning processes. Lighting design, equipment selection, and placement will focus on minimizing light pollution impacts: urban sky glow, light trespass, glare, and clutter. Urban sky glow is not expected to emanate from the facility to a perceptible degree with the anticipated lighting design and the lack of other light sources in the area. Light trespass, glare, and clutter will be minimized in the design and operation of the lights. It should be noted that lighting will be present during operations and to a lesser degree during initial reclamation. After closure, lighting will be minimal at the site.

Stationary outdoor lighting will be used from the mine entrance to the mine office and mill facilities. Light fixtures on utility poles will be installed along the roadway with additional fixtures located on buildings. Lighting in the pit and at the TWRMF will be accomplished by mobile light plants served by generators. Visibility of lighting in the pit will decrease as the pit deepens. The lighting needs at the TWRMF will be concentrated in the localized area of operations.

Glare will be minimized through the use of specific lighting technology and directional fixtures. Selections of halogen, light emitting diode (LED), and specialized florescent light bulbs will be considered throughout the equipment selection process. Motion sensors will be employed in appropriate areas to minimize light sources and conserve energy.

Comment #21:
Provide a plan for snow storage during the winter months on the contact area.

Response to Comment #21:
During winter months snow that accumulates in the contact area will be segregated from snow that accumulates in the non-contact areas. As shown on Figure 5-1 (MPA), contact snow will be stored in the snow storage area north of the OBA. During spring time, snow melt will flow to the contact ditch which reports to the pit. Non-contact snow will be stored in areas surrounding the facility outside of the contact area.

Pit Slope Design, Volume ID, Appendix C

Comment #22:
Provide clarification or an explanation as to how the proposed monitoring plans take into account the recommendations for geotechnical documentation and monitoring, specifically pit documentation during pit development, slope monitoring, surface displacement monitoring, water-level monitoring, monitoring of piezometric pressures in the northwest and southwest areas of the planned pit, and blasting-related monitoring.

Response to Comment #22:
Recommended pit slope monitoring including surface displacement monitoring, water-level monitoring, and blasting-related monitoring during operations are described in Section 6.7 of the Pit Slope Design (MPA, Appendix C, Volume ID). In addition, new Table 22-1 provided in Attachment 22 lists Mine Pit Monitoring activities that will be conducted by Aquila during operations.

Comment #23:
Groundwater seepage through the cutoff wall is estimated to be 123 to 4756 m3 per day (32,500 to 125,500 gpd – 22 to 87 gpm). During life of mine (LOM) further seepage analysis will be carried out in the ongoing project hydrogeological evaluation (p. 4, Volume ID, Appendix D). What are the specific plans for this analysis? How will seepage through the cutoff wall be monitored?

Response to Comment #23:
Performance of the cut-off wall will be monitored via piezometers or observation wells installed on either side of the cut-off wall. Proper wall performance will be indicated by steep horizontal gradients across the wall with groundwater elevations on the pit side of the wall showing substantially lower elevations than those on the river side. Piezometers will be installed in the unconsolidated overburden deposits as the wall is intended primarily to limit groundwater flow towards the pit within these more permeable deposits. As pit development progresses, groundwater elevations on both the pit side and the river side of the wall may drop below the base of the wall, at which point groundwater gradients will not be controlled by the wall.

The location and design of piezometers will be determined during completion of final construction plans. The locations will be included in the final construction plans which will be submitted to the State prior to construction.

Comment #24:
How were the operational considerations listed in Section 6, p. 41-46 taken into account in the proposed mine plan?

Response to Comment #24:
The current pit shell design was developed based upon the operation aspects presented in Section 6 of the Back Forty Pre-feasibility Study (MPA, Appendix C, Volume 1D). In summary, the design basis for the mine plan include:

Engineering Geology Model
An Engineer Geology Model (EGM) was developed that established overburden slope criteria and rock mass quality. The EGM is comprised of four geotechnical domains: overburden, slightly weathered zone, fresh bedrock zone, and shear/fault zones.

Structural Geology
Structural geology features were such fault zones, dyes and bedding planes and veins were evaluated that could affect the pit shell design.

Hydrogeology
Pit groundwater inflows will be mitigated via the cut-off wall to be constructed along the west, northwest, and southwest sides of the pit. Groundwater discharge to the pit will be collected via pit floor sumps and pumped to the CWB. In the event of localized seepage at rates sufficient to cause maintenance problems for pit roads or slope stability issues, mitigation measures will be undertaken and may include the installation of low-angle (5 to 10 degrees from vertical) passive drains or injection grouting to seal fractures.

The design basis was used to establish the slope designs factors including: overburden slopes, seepage control, set back distance from the Menominee River, and rock slopes. Aquila plans to conduct additional geotechnical testing that will be used to refine the EGM, the pit shell, and mine plan.

Comment #25:
No additional geotechnical investigation was carried out since 2010, and no new piezometers were installed in the pit area (Comment on the application of the 2011 Pit Slope Design to the 2015 Pit Shell for the Aquila's Back Forty Project, Technical Memorandum October 15, 2015, Golder). Since it is stated that no additional geotechnical investigations were carried out, explain how the considerations listed in Section 7, p. 46-47, that were offered for additional geotechnical studies to further advance the Back Forty pit slope design, were considered in the development of the mine, reclamation, and monitoring plans.

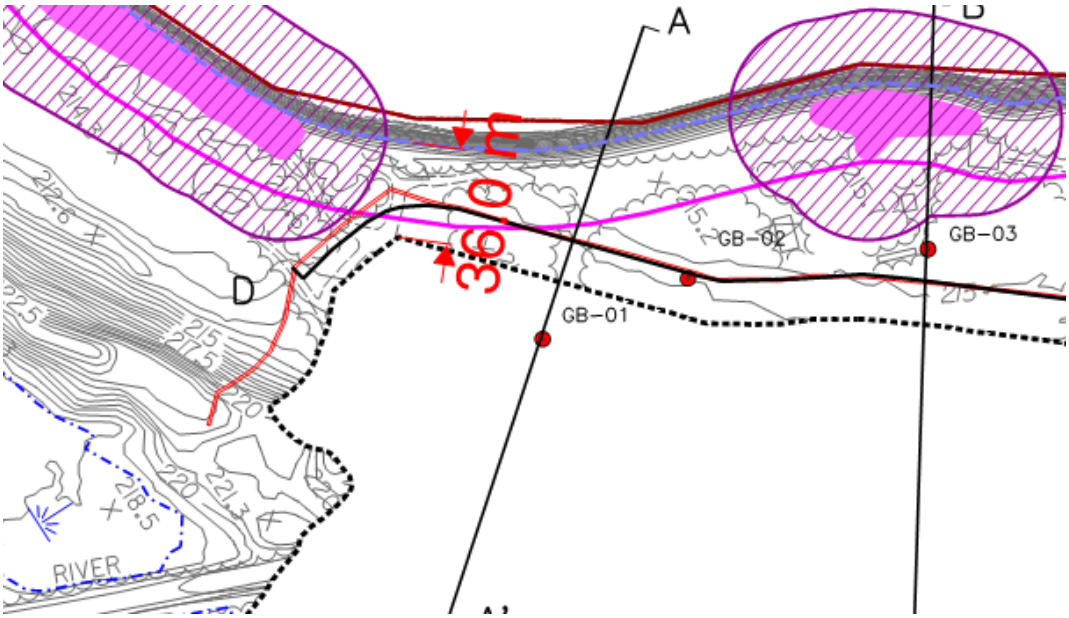
Response to Comment #25:
The pit slope designed by Golder was based upon available geotechnical information as noted in Response to Comment #24. This pit slope configuration was further revised by Tetra Tech in 2012 as part of the Preliminary Economic Assessment. Aquila also will be conducting additional geotechnical testing, which will be used to validate the pit slope design, mine plan, reclamation and monitoring plans.

Comment #26:
Section 3.0, (Final Remarks Comment on the application of the 2011 Pit Slope Design to the 2015 Pit Shell for the Aquila's Back Forty Project, Technical Memorandum October 15, 2015, Golder) -- "As the project advances beyond the Pre-Feasibility Study, it is recognized that additional effort is required on the evaluations of the minimal set-back distance to the river and what should be done to control potential seepage through the OB and upper BR surface into the pit. Further investigation is also required to assess for potential major geologic structures that could provide hydrogeological connection between the river and the pit." – How were geotechnical evaluations applied to determining the minimal set-back distance to the river for the proposed mine pit design? What plans are in place for further investigation to assess for potential major geologic structures that could provide hydrogeological connection between the river and pit? If major geologic structures are found to exist, what will the implications be for the mine pit design and the cutoff wall design, and how will they be mitigated?

Response to Comment #26:
Golder established a minimum setback distance of 25 meters from the ordinary high water mark (EL. 211.7m) to the pit crest. The distance was establish based upon:

- Stability of the overburdened material;
- Seepage and potential piping through the overburden that could cause instability of the overburden slope; and
- Construction for the cut-off wall.

For the current mine pit description, the minimum distance from the crest of the pit to the ordinary high water mark is 36.0 meters.



As noted in Response to Comment #25, Aquila plans to conduct additional geotechnical testing to further assess rock geotechnical and hydrogeological properties. This program will be used to validate the design of the pit slope in the northwest and southwest zones of the pit. This program will also further evaluate the overburden properties and potential hydrogeological connection to pit, validating the design of the cut-off wall.

Cut-off Wall Design, Volume ID, Appendix D

Comment #27:
The CSM (Cutter Soil Mixing) method was determined to be best suited for the Back Forty Project. Is this the method that is proposed? Provide a plan for placement/control of soils/bentonite slurry removed from the trench in preparation for the possibility that the TC (Trench Cutter) method may be utilized.

Response to Comment #27:
The CSM is the proposed method for the cut-off wall construction.

If the TC method of construction is used, the excavated trench is filled with bentonite slurry as necessary to ensure that the trench remains open. During excavation, the slurry which contains

the cutting from the overburden soil and rock is pumped through a screen and a desander where the cuttings are removed. The reconditioned bentonite slurry is then recycled and continuously used to stabilize the trench and transport cutting to the desander. The screened cuttings will be transported to the overburden stockpile areas within the Mine Site. Once the trench excavation (individual panel) has reached the designed depth, the trench will be backfilled with soil-cement-bentonite (SCB) mix using a tremmie pipe. The displaced slurry will be pumped to storage tanks for disposal off-site. The TC method is usually used where very deep penetration (up to 120 meters) in dense or bedrock formation is required and is not the preferred method for the Project site.

Comment #28:
Figure 1 – distance shown on the map on the west side of pit shows cutoff wall 28 meters from river. Explain how this meets the proposed cutoff wall setback of 100 feet from the river ordinary high water mark.

Response to Comment #28:
The distance shown on Figure 28-1, located in Attachment 28, has been revised to show the setback distance of 30 meters. Final setback distance will be established during final design and construction and will incorporate all setback requirements.

Comment #29:
Preliminary seepage analysis, based on the proposed cutoff wall profile, approximately 400 m (meters) in length indicated the seepage through the cutoff wall ranges from 123 to 4756 cubic meters per day (32,500 to 125,500 gpd) during the LOM. – Clarify whether this seepage is before or after construction of the cutoff wall. What is the total seepage into the pit before and after cutoff wall construction?

Response to Comment #29:
The estimates in Volume 1D, Appendix D were developed during a preliminary analysis using a simplified 2-D model. An improved estimate of seepage through the wall and pit inflow was developed using a 3-dimensional groundwater flow model (MODFLOW). Groundwater inflow (seepage) to the pit without a cut-off wall constructed is projected to be (in cubic meters per hour [m^3/hr]:

- Mine Year 1 = 13.0
- Mine Year 2 = 20.8
- Mine Year 3 = 72.4
- Mine Year 4 = 71.4
- Mine Year 5 = 85.9
- Mine Year 6 = 59.3
- Mine Year 7 = 37.1

Groundwater (seepage) with the cut-off wall in place is projected to be (in m^3/hr):

- Mine Year 1 = 12.6
- Mine Year 2 = 20.7
- Mine Year 3 = 34.7

- Mine Year 4 = 32.0
- Mine Year 5 = 19.3
- Mine Year 6 = 44.8
- Mine Year 7 = 31.7

Comment #30:
Explain the plan to monitor the effectiveness and integrity of the cutoff wall, including appropriate performance measures.

Response to Comment #30:
A comprehensive geotechnical monitoring program will be implemented to monitoring the performance and integrity of the cut-off wall during mine operation. Geotechnical monitoring instruments will be installed during construction of the cut-off wall.

The performance monitoring parameters are:

Piezometer Levels
A series of vibration wire piezometers will be installed at the downstream face of the cut-off wall with multiple piezometer tips at the bedrock and various depth in the overburden. Additional conventional stem pipe piezometers will also be installed further downstream from the cut-off wall. The measured piezometer level will be compared with the upstream river level as well as with the piezometer levels as predicted in the seepage analysis models. Elevated piezometer level is an indicator of distress such as leakage.

Seepages
Seepage at the toe of the overburden slope will be monitored. Seepage will be drained in to a weir for flow measuring. The quantity of the flow will be compared to the predicted flow as modelled in seepage analysis. High flow rate coupled with elevated piezometer levels indicates the performance of the cut-off has been compromised.

Ground Movements and Vibration
Inclinometers will be installed downstream of the cut-off wall at strategic locations such as the deepest portion of the wall and near the abutments to measure the lateral movements of the ground in the direction normal to the cut-off wall. Movements may be caused by erosion of slope surface, slope instability or vibrations due to blasting or seismic events that may affect the integrity of the cut-off wall. Movement may also be caused due to settlement of the cut-off wall. Based line monitoring data shall be established prior the pit operation. Accelerometers may be installed in the cut-off wall to measure ground acceleration induced by blasting. United States Bureau of Mine stipulated that a ground acceleration of not great then 2 inches per second will have minimal effects on buildings and structures. Explosive charges will be designed to limit the vibration effect on the cut-off wall when blasting is carried out nearby.

Survey monuments or settlement gauges will also be installed on top of the cut-off wall for monitoring vertical movements of the cut-off wall.

Other Distress Indicators
Routine inspections are to be carried out to observe anomalies such as wet surface and depressions on the ground and slope surface downstream of the cut-off wall. Ground surface depressions will also be observed upstream of the cut-off wall.

The color of the seepage will be observed. Muddy generally suggests a sign of internal erosion has occurred in the ground.

Data Collection and Review
All monitoring data will be reviewed by the geotechnical engineer on a regular basis to establish any trend in elevated piezometer levels and seepage rates.

Mitigation and Contingency Measures
If the cut-off wall is determined through performance monitoring to be ineffective for its intended purpose, the following Mitigation and Contingency Measures will be implemented.

1. Determine the locations of leaks based on piezometer and flow monitoring results.

2. Commence a site investigation and testing program to assess the integrity of the cut-off wall starting with the suspected location of leak. The program shall comprised coring of the SCB cut-off wall for examination for defects and testing in the laboratory. A borehole televiewer shall be used to inspect the borehole wall for cracks and the presence of any soil particles within the cracks. Down holes permeability testing is not recommended as the water pressure may induce cracks in the SCB cut-off wall. Down hole permeability tests may be carried out in the bedrock to further assess their hydraulic conductivities.
3. Based on the investigation results, a remedial design and construction shall be carried out. Typical remedial measures comprise grouting of the cut-off wall and the bedrock foundation, installing water pressure relief wells downstream.

4. In the meantime additional sumps and pumps shall be provided at the toe of the overburden slope downstream of the cut-off wall to collect and divert the seepage.

5. Additional sumps and pumps may also be carried for the pit dewatering.

Hydrogeology

Comment #31:
MPA, Vol 1, Section 5.7.6 and Figure 5-9: What is the containment plan for tailings pipeline and other process pipelines to capture leaks and keep from entering groundwater in areas where pipelines are outside of the lined tailings areas?

Response to Comment #31:
The tailings pipeline will be thick walled high-density-polyethylene, uncontrolled leaks outside of the dump pond are highly unlikely. In the unlikely event of a leak, tailings will be contained in a lined continuous channel running along the entire alignment of the pipelines and diverted to

a geomembrane lined dump ponds. Spilled tailings will be contained within the pipeline channel and dump ponds. Spills will be cleaned up immediately with mechanical equipment.

Process pipelines will be a double containment system having an inner carrier pipe inside the outer containment pipe. Any liquid that leaks from the carrier pipe will be contained within the outer containment pipe.

Comment #32:
MPA, Vol 1, Table 5-8: This monitoring and inspection plan includes visual inspection of pipelines and repair of leaks. Provide procedures for cleanup of spills from leaks.

Response to Comment #32:
Cleanup procedures for spills and leaks depend upon the material that will be carried with the pipeline. For tailing pipelines, spills will be contained within the lined channel and dump ponds as describe above in Response to Comment #31. Mechanical equipment will be used to remove the tailings which will then be transported to the TWRMFs.

Process water pipelines will be designed with a double containment system consisting of a carrier pipe inside of a containment pipe. Leaks from the primary carrier pipe will be contained within the outer containment pipe. Spills from process pipelines will be very unlikely due to the double containment pipe system. If a spill does occur, Aquila will immediately mobilize spill containment teams to clean the area of the spilled product. More details regarding spill containment and cleanup procedures will be included in the Project Spill Prevention and Pollution Control Plan to be completed before operations.

Comment #33:
MPA, Vol ID, Appendix E, Section 2.1.2 and Figure 1-1: Non-contact storm water is sent to storage basins, which then discharges to topographically low zones in the project area. Do any of the conveyance pipelines exist in areas considered non-contact areas? If so, what is the plan to keep releases from spills and leaks from the non-contact storm water storage basins?

Response to Comment #33:
No contact water conveyance piping will be installed in non-contact drainage areas. Conveyance piping will be located in areas that drain to the CWB.

Comment #34:
MPA, Vol IE, Appendix J, Section 2.2: It is common for a third-party vendor to arrange for an on-site or near-site storage magazine for explosives and an on-site location and/or mix plant for ANFO (Ammonium Nitrate/Fuel Oil) products. If this is the case, where will this be located, and how will groundwater be monitored for possible impacts from releases of nitrates?

Response to Comment #34:
Presently Aquila is not planning on mixing or storing explosives on-site. The proposed blasting agent will be ammonium nitrate fuel oil (ANFO) and will be mixed in the shot hole by the blasting contractor, which will supply the blasting materials as needed. If Aquila decides to have on-site mixing or storage of blasting agents, the location, design, and construction of magazines

and mixing plants will meet Mine Safety and Health Administration rule requirements for such materials.

Comment #35:
MPA, Vol IE, Appendix J, Section 2.3 and Figure 2-3: Provide detail of fuel storage area and groundwater monitoring plans for review of adequacy of early warning for potential fuel releases.

Response to Comment #35:
The fuel storage area design and construction details will be developed with other site and structure design. Fuel will be managed in new above-grade tanks within secondary containment. Both tank fill and vehicle refueling will take place within a curbed concrete sloped surface that will prevent releases to the environment. The area will be sheltered to minimize precipitation collecting in the containment. Contingency measures required to mitigate a fuel spill will be provided in the Pollution Incident Prevention Plan/Spill Prevention, Control, and Countermeasures Plan (PIPP/SPCC), to be developed prior to operations. The PIPP/SPCC Plan will include safety and spill prevention work practices, containment description, and inspection procedures including tank integrity testing to verify that the storage tanks and containment are adequate for service.

Groundwater monitoring will include regular sampling for petroleum-related parameters in monitoring wells adjacent to the fuel station. In addition to the sample parameters listed in Table 2-1 of the Environmental Monitoring Plan (MPA, Volume IE, Appendix J), monitoring wells CW-2, -8 and -9 will be tested for benzene, toluene, ethylbenzene, and xylene (BTEX) on a quarterly basis during operations. During postclosure, sampling will be performed semiannually for a period of one year after fuel supplies are removed from the site, provided no detections are identified. Should fuel spills reach the environment, cleanup in accordance with the PIPP/SPCC Plan and other applicable rules and regulations will be initiated promptly.

Comment #36:
MPA, Vol IE, Appendix J, Section 2.12.5: Since the applicant states there is a potential for chemical reagents to reach the environment, more detail of the off-loading zone, storage zone, and use areas is necessary to allow a review of the adequacy of planned secondary containment and early warning detection systems. How will potential groundwater impacts from this area be monitored?

Response to Comment #36:
During operations, a variety of reagents and typical industrial chemicals and products will be delivered to the facility. Similar to any other industrial facility, loading docks will be used for incoming packaged materials. Bulk chemicals (both liquid and granular) and petroleum products will be off loaded from tanker trucks to tanks and silos. Loading/fill connections will be designed to facilitate safe and efficient material transfer. All materials will be stored in appropriate containers, whether that be aboveground storage tanks, silos, hoppers, drums, totes, or other packaging. Any materials stored outside will be contained in weather tight containers in areas designed for such purposes. Dispensing will be conducted via industry standard equipment as appropriate.

Spill prevention of all hazardous and reactive reagents and chemicals will be implemented under the PIPP, SPCC Plan, and Storm Water Pollution Prevention Plan (SWPPP) that will be prepared and provided before operations. All loading and transfer areas will be designed with secondary containment. Storage tanks will be provided with a concrete enclosure having storage capacity equivalent to the largest storage tank.

Unloading and management of all products will be conducted by trained personnel. Contract vendors will be trained on the PIPP, SPCC, and SWPPP, as appropriate. If spills do occur, absorbent socks or pads will be immediately deployed. Furthermore, areas that are contaminated by spills will be immediately cleaned up preventing product release to the environment.

Specific design details for loading docks and bulk storage tanks and silos will be developed during design. These facilities will be designed and detailed in accordance with industry standards and good engineering practice. The PIPP, SPCC, and SWPPP will be prepared and available for review prior to operations.

Routine groundwater monitoring will not be conducted at the chemical off load areas. Because of spill prevention controls and off-loading procedures, such routine monitoring will not be necessary. Should a particular spill occur that potentially could affect groundwater, monitoring for such effects will be implemented as part of the cleanup. Groundwater monitoring will be conducted as part of the project-wide Environmental Monitoring Plan.

Comment #37:
EIA, Vol IIA, Appendix D, Table 5.1: A number of groundwater sample locations had Gross Alpha Activity analysis results well over 15 pCi/l, but the combined radium 226 and 228 results do not account for more than a fraction of the Gross Alpha activity. Why was Uranium not included in the baseline sampling?

Response to Comment #37:
The parameter list was developed based on precedent set by Part 632 baseline studies at other mine sites in Michigan at that time and did not include uranium. The parameters list was reviewed in two meetings that took place in March and September 2007, prior to sampling. Attendees to one or both meetings included representatives from Aquila, MDEQ, ERM, and MDNR Escanaba Forest Management Unit.

Comment #38:
EIA, Vol IIB, Appendix C: Explain why observation wells for aquifer tests were not constructed the optimal 1.5 to 5 times aquifer thickness distance away. Explain how the placement of observation wells at less than 1 times the aquifer thickness away provided good data for type curve matching and analysis, and that how that data was not influenced by the steep slope of the drawdown cone near the pumping well.

Response to Comment #38:
None of the observation wells in any of three tests are located so close to the pumping wells as to be influenced by well losses at the pumping well. Therefore, data gathered from all observation wells is useful for characterizing the hydraulic conductivity of the formation. The saturated formation thickness at PW-2SS, PW-4SS, and PW-18 is 38 feet, 98 feet, and 20 feet,

respectively. The distance to the furthest observation well for each of these tests, expressed as a multiple of saturated thickness at the pumping well is 1.32, 1.30, and 2.1, respectively. While locating observation wells further from a pumping well may allow testing of a larger areal section of the formation, locating an observation well too far from the pumping well carries the risk of observing no drawdown and characterizing nothing. The maximum drawdown and pumping test durations for PW-2SS, PW-4SS, and PW-18 are 2 feet/24 hours, 2.5 feet/41 hours, and 1 foot/24 hours. These observations indicate that minimal drawdown was observed at the most distant well in each of the tests, in spite of long test times of one day or greater. Locating the observation wells further from the pumping well would have yielded minimal or no drawdown, rendering the distant monitoring well of no value in characterizing the aquifer test.

Comment #39:
Provide both an overlay and cross section diagrams showing groundwater surface before pit dewatering and at point in time when maximum dewatering is occurring. Cross section should show river and slurry wall on one end, and the maximum extent of dewatering impact on the other end, and should cut through the natural groundwater divide going through the project area.

Response to Comment #39:
Groundwater inflow to the pit is projected to peak at 44.8 m^3/hr in Mine Year 6. Figures 39-1 (plan view of existing conditions and Mine Year 6 groundwater elevations) and 39-2 (cross section view of existing conditions and Mine Year 6 groundwater elevations) present plan and section views of groundwater elevations under existing conditions and Mine Year 6 conditions with a cut-off wall in place. These figures are provided in Attachment 39.

Comment #40:
Explain why groundwater contours all converge to a single central point in the pit area in Figure 3-11 (Volume II).

Response to Comment #40:
Figure 3-11 shows groundwater elevation contours for the Precambrian bedrock. The close spacing of the contours shown near MW-9PC reflect a zone of steep gradients directed towards the river. The river likely serves as zone of discharge for shallow groundwater and steepened gradients are common near groundwater discharge zones. Additionally, because the bedrock possesses virtually no porosity, all groundwater movement within the bedrock takes place via fractures. The steepened gradients near MW-9PC are likely the result of a reduced fracture frequency that gives rise to low hydraulic conductivity, increased head loss, and subsequent steep gradients as shown on Figure 3-11.

Comment #41:
Two different recharge values were used in the application. Most of the application refers to 7 inches per year, but the model the input was 10 inches per year. What is the basis, and why is the change valid?

Response to Comment #41:
A value of 10 inches per year was the initial value selected for recharge during groundwater flow model development. This value was assumed high but was used for initial model development to

prevent numerical instability as parameter estimation refined the parameter assignments in the model and improved numerical stability. The calibrated value obtained for the final model and reported in the modeling report is 7 inches per year. This value is consistent with that reported by the United States Geological Survey (USGS).

Comment #42:
What will be the impact to river recharge since pit dewatering will intercept groundwater normally discharging to the river?

Response to Comment #42:
The projected peak inflow to the pit (Mine Year 6) is 44.8 m^3/hr or 197 gallons per minute (gpm). Some of this water will be induced seepage from the river and some will be groundwater inflow from the north, east, and south. Even if all of the groundwater inflow is assumed to otherwise be water that would discharge to the river, the total reduction in Menominee River discharge would be 197 gpm or 0.44 cubic feet per second (cfs). With the 90-day, 10-year low flow equal to 1,370 cfs, the pit inflow impact would at most represent a 0.03% reduction in river flow at one of its lowest discharge. During normal conditions, the reduction expressed as a percent of discharge would be smaller. Accordingly, the impact of pit dewatering on river discharge will be minor.

Comment #43:
Explain the high value for nitrates in MW-20, and how this will be assessed moving forward.

Response to Comment #43:
The nitrate value of 7.1 milligrams per liter (mg/L) measured at MW-20 is elevated compared to nitrate baseline values measured in other monitoring wells. However, the value at MW-20 is below the United States Environmental Protection Agency drinking water maximum contaminant level of 10 mg/L. The well is located on privately-owned land. The elevated nitrate level may be partially related to the current use of this property. Plans do not exist to investigate the nitrate source further.

Comment #44:
The Mining Team recommends that additional monitoring wells will be needed to account for divergent groundwater flows across the project area due to groundwater divides. The following locations are advised:

- *Well located southwest of pit near river.*
- *Well located south of pit and all storage locations.*
- *Well located east of pit, north of pipeline and west of flotation tailings basin.*
- *Well located north of flotation tailings basin and west of oxide tailings basin.*
- *Two wells located south of entire processing facility bracketing the east and west edges.*

Provide an updated monitoring plan that addresses this comment.

Response to Comment #44:
CW-11 was added southwest of pit near river.

MW-8 was added south of pit and stockpile.

MW-2 was added east of pit and west of TWRMF. Unsure what pipeline is referred to in comment.

There are already three wells located north of flotation tailings basin and west of oxide tailings basin: LW-3, CW-3, and LW-2.

CW-12 was added south of processing facility. Wells are already proposed within the processing facility and south of the CWB. A single well (CW-12) has been added and is centrally located south of the processing facility footprint; this location will best serve to detect contaminants released into the groundwater and migrating south.

A revised monitoring well figure is provided in Attachment 44 as Figure 44-1. A revised monitoring well table is also provided in Attachment 44 as Table 44-1.

Comment #45:
The Mining Team recommends that additional monitoring wells will be needed to be added to the post closure monitoring plan to account for divergent groundwater flow across the area. The following locations are advised:

- *Well southwest of pit near river.*
- *Two wells south of entire processing facility.*
- *Well east of pit, west of flotation tailings basin, north of pipeline.*
- *Well west of oxide tailings basin and north of flotation tailings basin.*

Provide an updated post closure monitoring plan that addresses this comment.

Response to Comment #45:
CW-11 was added southwest of pit near river.

CW-12 was added south of processing facility. Wells are already proposed within the processing facility and south of the CWB. A single well (CW-12) has been added and is centrally located south of the processing facility footprint; this location will best serve to detect contaminants released into the groundwater and migrating south.

MW-2 was added east of pit and west of TWRMF.

There are already three wells located north of flotation tailings basin and west of oxide tailings basin: LW-3, CW-3 and LW-2.

Revised postclosure monitoring wells are shown in Attachment 45 as Figure 45-1. A revised monitoring well table is also provided in Attachment 45 as Table 45-1.

Storm Water Management Plan, Volume ID, Appendix E

Comment #46:
Non-Contact Water Basins (NCWBs) – At what point in the project timeline will the Northwest and South ponds be removed?

Response to Comment #46:
The Non-Contact Water Basins (NCWB) will remain after the postclosure period to remove sediment from surface water that is received from the closed TWRMF. Eventually the NCWBs surrounding the closed TWRMF will fill with sediment and act as a bio-filter improving water quality that is received from the closed TWRMF.

Comment #47:
Section 2.3, Other Non-Contact Storm Water – "Storm water runoff from the topsoil stockpiles will be seeded, and the vegetation growth will minimize sediment yield, therefore negating the need for directing this runoff to storm water basins." Which topsoil stockpile(s) is this statement referring to on Figure 1-1? Since the need to direct runoff to storm water basins is negated because of seeding, does this imply that not all stockpiles will be seeded as proposed in the Soil Erosion and Sedimentation Control (SESC) Plan? (Figure 5-12 in the MPA, Soil Erosion Control Plans – Operations Phase, shows that all topsoil and overburden stockpiles are proposed to be seeded.)

Response to Comment #47:
As shown on Figure 5-12 (MPA), all of the topsoil stockpiles will be seeded. This corresponds to all the topsoil stockpiles shown on Figure 1-1 (provided in the Storm Water Management Plan). In addition, the overburden and general soils stockpile will also be seeded. Storm water run-off from the topsoil stockpiles will not report to non-contact storm water basins except for the topsoil stockpile directly northwest of the overburden/general soil stockpile.

Comment #48:
Flow rate to liner system on TWRMF post closure – proposing to pump leachate (small quantities after year 6) into trucks and transporting to a local Wastewater Treatment Plant (WWTP) for disposal after on-site WWTP is reclaimed, or will be treated through an alternative on-site treatment process. Appendix I, Reclamation Plan – "At mine year 16, leachate generated by the TWRMF will be de minimis." However, there are plans in place to continue treatment offsite. How long will water have to be removed and treated off site after final reclamation?

Response to Comment #48:
Schematic 5-4 in Section 5-4 of the Water Management Plan (Appendix D from the Treatment and Containment Plan) shows leachate from the TWRMF will report to the on-site wastewater treatment plant (WWTP) through Postclosure Year 6 (Mine Year 17). From Postclosure Year 7 to Postclosure Year 50 (Mine Year 61) leachate will be pumped into tanker trucks and will be transported off-site for treatment. The estimated leachate generation rate during Postclosure Years 50 to 100 are presented in Table 48-1 located in Attachment 48. As presented, the quantity of leachate during this period is extremely small.

Comment #49:
How will the noncontact storm water basins be maintained after closure?

Response to Comment #49:
Non-contact storm water basins will remain after postclosure. As discussed in Response to Comment #48, eventually the NCWBs surrounding the closed TWRMF will fill with sediment and act as a bio-filter improving water quality that is received from the closed TWRMF.

Comment #50:
In Section 3.3, page 12 of the Storm Water Management Plan it states that the emergency overflow from the contact water basins will be an earthen weir with a ditch to the pit. Where will this be located considering that the storm water management plan shown in Figure 1-1 shows non-contact storm water conveyances and material processing/stockpiles between the contact water basins and the pit? In the Contingency Plan, if a runoff event exceeds the capacity of the CWBs, it is proposed to route excess water to the TWRMF for emergency temporary storage, and as an additional contingency, water can be pumped into the mine pit for additional temporary storage in the event adequate storage is not available at the TWRMF. Provide clarification as to the plan for emergency overflows in the CWBs.

Response to Comment #50:
Under an unlikely storm event that would exceed the capacity of CWBs, the principle method for excess water management will be pumping to the pit or pumping to the TWRMFs. During an emergency situation, water will be discharged through a weir to a ditch routed to the pit as shown on new Figures 50-1 and 50-2, Attachment 50.

Surface Water

Comment #51:
EIA, Volume II, Section 3.5.2, Table 3-10 and second bullet on page 25: Clarify whether the calculation for un-ionized ammonia or total ammonia was used. The water quality standard is an un-ionized ammonia number.

Response to Comment #51:
Baseline surface water quality data documented in the EIA, Appendix D-1 (Hydrogeology Report, [ERM, 2011]), reports total ammonia for the surface water samples and the comparison presented in EIA, Table 3-10 uses the un-ionized ammonia standard presented in Michigan Rule 57 Surface Water Criteria. Because un-ionized ammonia is a portion of total ammonia, the comparison of the reported total ammonia to the un-ionized ammonia standard is informative, however; a better approach is to compare baseline un-ionized ammonia to the appropriate standard. The concentration of un-ionized ammonia is dependent on temperature and pH. The MDEQ recommended method for converting total ammonia concentration (Emerson, et al., Journal of the Fisheries Research Board of Canada, Volume 32(12); 2382, 1975) to an estimated un-ionized ammonia concentration was used to perform a more informative comparison. Upon review of converted un-ionized ammonia concentration estimates, there are no ammonia exceedances of Rule 57 Final Chronic Value in the baseline surface water data.

Comment #52:
EIA, Volume II, 3.13.1 Aquatic Biota and Habitats Within Mining and Affected Areas, Page 39: Aquila states that a fish community consisting of 5 percent salmonid species is the criteria for a stream meeting Michigan's cold water standard. This is not correct; it is a 1 percent salmonid population. Reanalyze the results based on this standard.

Response to Comment #52:
A search of ERM supplied reports do not indicate that ERM stated the Michigan Cold Water Standard was 5%. On page 39 ERM states AQ10 met the designation with a brook trout relative abundance of 5%. ERM did not state 5% was basis of the designation standard. The only study area where salmonids (brook trout) were collected exceeding the 1% standard was AQ10 and this segment is already a designated trout stream.

Comment #53:
EIA, Volume II, Table 3-9 Surface Water Analytes for Environmental Baseline Studies: Explain why so many water quality constituents were dropped for the 2010 and 2011 sampling dates.

Response to Comment #53:
Baseline data for surface water sampling is documented in the EIA, Appendix D-1. Over two years of comprehensive data spanning from September 2007 to June 2009 fulfills the baseline data required in R 425.202(3). Subsequent sampling events were reduced in scope because regulatory requirements had already been satisfied.

Comment #54:
EIA, Volume II, Table 3-10 Summary of Surface Water Quality Baseline Sampling Exceedances: Provide a comparison of predicted effluent data from the Back Forty Mine WWTP with Wisconsin Water Quality Standards and provide a table showing the comparison.

Response to Comment #54:
The WWTP is proposed to discharge to the Menominee River, which delineates the Michigan – Wisconsin border. Both states have delegated authority from the United States Environmental Protection Agency (USEPA) to administer National Pollutant Discharge Elimination System (NPDES) permit programs and to protect overall water quality in the waters of their state. The states must at a minimum meet federal Clean Water Act (CWA) standards, however, they are responsible for designating water usage and promulgating water quality standards. These standards can be more stringent than federal standards and are developed on a variety of bases.

With states pursuing individual programs under the CWA framework, differences in terms, standards, and technical approaches have developed. Table 54-1 presents the Michigan and Wisconsin terminology and definitions for the Menominee River designation/use and water quality standards/criterion. Governing water quality rules in both states address numerical water quality standards for a variety of constituents and also define methodologies to evaluate acceptable wastewater discharge limits, called water quality based effluent limits (WQBEL). It should be understood that WQBELs are the basis of permit limits. WQBELs are developed based on characteristics of the Project and baseline information. The acceptable concentrations can appear to be very high in comparison to water quality standards, however; they are

developed to maintain and protect the water quality standards of the receiving water, in this case, the Menominee River.

WQBELs consider how assimilative the receiving water (in this case, the Menominee River) is to the permitted discharge. Because the Menominee River has large flow in comparison to the WWTP discharge (107,000 m^3/hr vs. 150 m^3/hr, see Comment Response 175), the river can accept a higher concentrations of constituent loads (termed waste load allocations) and maintain its own water quality characteristics. Comparing the WWTP effluent concentration to the water quality standards, whether they be Michigan or Wisconsin, does not account for the assimilative capacity of the river.

The estimated WWTP effluent concentrations and the draft permit limits have been developed based on Michigan methodology and standards. Wisconsin methodology and standards are similar, but not identical. Rules governing these requirements for the two states include (but are not limited to):

Michigan
Statute Part 31 of NREPA Water Resources Protection:
Part 4 Water Quality Standards
Part 8 Water Quality Based Effluent Limit Development for Toxic Substances

Wisconsin
Wisconsin Administrative Code Chapters:
NR 102 Water Quality Standard for Wisconsin surface Waters
NR 105 Surface Water Quality Criteria and Secondary Values for Toxic Substances
NR 106 Procedures for Calculating Water Quality Based Effluent Limitations for Point Source Discharges to Surface Waters.

Table 54-2, located in Attachment 54, presents estimated WWTP effluent characteristics, draft permit limits (MDEQ, 2016), Menominee River Baseline Characteristics and Michigan and Wisconsin standards and criteria. Each is clarified below:

- Estimated WWTP Effluent Concentrations: The NPDES application provides a description of methods and background information on the estimated effluent concentrations. Treatment requirements are based on the WQBELs. Draft permit limits equal or exceed estimated effluent characteristics.

- Draft Permit Limits: MDEQ provided limits in correspondence (Email April 7, 2016).

- Menominee Baseline Characteristics: Data from Hydrogeology Report (ERM, 2011). Water quality values are geometric mean of 8 quarters of baseline data at MSG-10, adjacent to the Project. Hardness values have been averaged.

- Michigan and Wisconsin Water Quality Standards and Criterion: Based on the Menominee River designation, the standards and criteria presented are the lowest in value when alternatives were present.

Discrepancies between Michigan and Wisconsin Water Quality Standards can be present for a variety of reasons, including non-analogous basis (see Table 54-1 in Attachment 54), differing parameter species, and different scientific development basis. For example, silver has an aquatic standard in Michigan whereas the criterion in Wisconsin is much higher with a human health basis. As stated above, the Project discharges in Michigan with the mixing zone residing in Michigan. Wisconsin waters will not experience noticeable water quality impacts from the Project.

Comment #55:
EIA, Volume II, Figure 3-16 Surface Water Monitoring Locations: Provide location information for these stations, or refer to another table in the Environmental Impact Statement that includes the latitude and longitude coordinates.

Response to Comment #55:
Location information is provided in Table 2.1 of the EIA, Volume IIA, Appendix D-1 (Hydrogeology Report, ERM, 2011). The UTM coordinates of the table were converted to longitude and latitude coordinates (in decimal degrees) for the surface water monitoring locations as shown below.

Surface Water Station	Longitude X	Latitude Y
MSG-1	-87.84253047	45.42067521
MSG-2	-87.82074879	45.41550164
MSG-3	-87.78635801	45.42050841
MSG-4	-87.76443477	45.44943693
MSG-5	-87.75038542	45.44867032
MSG-6	-87.76761881	45.46419466
MSG-7	-87.76283686	45.47178551
MSG-8	-87.81193755	45.46409072
MSG-9	-87.80469452	45.47250087
MSG-10	-87.8350794	45.45090613
MSG-11	-87.8663528	45.38415846
MSG-12	-87.77272923	45.4558503
MSG-13	-87.82986579	45.45705168
MSG-14	-87.84754471	45.44360004
MSG-15	-87.82276211	45.43130476
MSG-16	-87.80170459	45.48036555
WSG-1	-87.87387106	45.44722443
WSG-2	-87.87441514	45.41764556
WSG-3	-87.87948161	45.38447958
WSG-4	-87.89289507	45.42385718
WSG-4	-87.89289507	45.42385718
WSG-5	-87.87504694	45.47397266
WSG-6	-87.84003651	45.5025684
WSG-6	-87.84003651	45.5025684
WSG-7	-87.87420568	45.49552948
WSG-7	-87.87420568	45.49552948
WSG-8	-87.84426947	45.45211167
WSG-8	-87.84426947	45.45211167

Surface Water Station	Longitude X	Latitude Y
WSG-9	-87.8127103	45.47645778
WSG-9	-87.8127103	45.47645778
USGS 04066030	-87.80222222	45.48194444

Comment #56:
EIA, Volume II, Appendix D-1, Section 5.2.2. Page 43: Why do the hardness values stated in this section not match those in table 5.2?

Response to Comment #56:
Upon review, it was confirmed that the hardness range given in Section 5.2.2 of the ERM Hydrogeology Report does not accurately reflect the values in Table 5.2 of that report. The hardness values in Table 5.2 range from 94 to 130 mg/L for the Menominee River and 70 to 260 mg/L in Menominee River tributaries.

Comment #57:
EIA, Volume II, Appendix D-1, Section 5.4, Table 2.1: Provide the location information for sampling locations in latitude and longitude decimal degrees.

Response to Comment #57:
See Response to Comment #55.

Comment #58:
EIA, Volume II, Appendix D-1, Section 5.4, Table 5.2: Why is there no data included for MSG2, MSG15, or MSG16?

Response to Comment #58:
These locations are gaging stations. No water quality data was collected from these locations. Please refer to Figure 3-16 of the EIA for a depiction of station types.

Comment #59:
EIA, Volume II, Appendix D-1, Section 5.4, Table 5.2: Is there an explanation for hardness data varying a great deal in the Menominee River when moving from upstream station (MSG-8) to downstream stations (MSG-13, 10, 14)? The hardness values ranged from 160-260 milligrams per liter (mg/L) at the upstream MSG-8 site to a range of 94-130 mg/L at the downstream stations.

Response to Comment #59:
MSG-8 is located on a tributary to the Menominee River and drains an area underlain by Paleozoic rocks with relatively abundant calcium carbonate. The hardness range for MSG-8 is consistent with hardness results from all of the other sample locations on tributaries on the Michigan side of the Menominee River. Menominee River monitoring locations MSG-13, -10 and 14 have a narrower hardness range that is consistently lower than the Michigan tributaries.

Comment #60:
MPA, Volume ID, Appendix G, Table 2-1: What is the plan for water quality monitoring during Phase 1 of post closure?

Response to Comment #60:
The proposed water quality monitoring plan for Phase 1 postclosure, including sampling frequency and parameter list, will be the same as what is proposed for operations, a quarterly frequency.

Comment #61:
MPA, Volume ID, Appendix G, Table 5-1: Why are MSG-4, 5, 11, and 12 not included in the surface water monitoring plans?

Response to Comment #61:
Surface water stations are shown on EIA, Figure 3-16. The surface water stations on Table 5-1 of the Environmental Monitoring Plan should represent locations on the Menominee River, Shakey River, and Shakey Lakes upstream and downstream of the Project. The tables in the plan have been updated and are provided in Attachment 61.

From the perspective of monitoring the rivers for effects from the Project, stations MSG-4, -5, -11, and -12 are not needed since any effects from the Project will be first noted at the stations on the corrected tables.

Comment #62:
MPA, Volume ID, Appendix G, Table 5-1: What water quality parameter testing will be included at these sites?

Response to Comment #62:
The sample locations shown in the Environmental Monitoring Plan, Table 5-1 will be analyzed for the parameters shown in Table 2-1.

Comment #63:
Provide a plan for additional surface water quality sampling and macroinvertebrate community surveys, prior to operations, to confirm seasonal baseline conditions, including, if possible, the following smaller streams, and as close as practicable to the following locations:

Spring Creek	*-87.827660 45.438550*
Boerner Upper	*-87.811100 45.462200*
Boerner Lower	*-87.812240 45.464210*
Unnamed Tributary Schonecks	*-87.805010 45.472760*
Unnamed WE Creek	*-87.800910 45.480580*

Response to Comment #63:
The five proposed surface water monitoring locations are summarized below in Table 63-1 and shown on Figure 63-1 (Attachment 63). Aquila proposes one year of water quality monitoring and macroinvertebrate surveys prior to construction for these locations.

The presence of a stream at the Spring Creek location is unclear from examination of maps and satellite photographs. If the property owner grants access, Aquila proposes that this location be included for one year of water quality monitoring and macroinvertebrate surveys.

Table 63-1

Summary of Pre-Construction Surface Water Monitoring Stations

Location Description	Surface Water Sampling Station from ERM (2011)	Station Type
Spring Creek	MSG-17	1 year of pre-construction water quality monitoring and macro-invertebrate surveys
Boerner Upper	MSG-18	1 year of pre-construction water quality monitoring and macro-invertebrate surveys
Boerner Lower	MSG-8	1 year of pre-construction water quality monitoring and macro-invertebrate surveys
Unnamed Tributary Schonecks	MSG-9	1 year of pre-construction water quality monitoring and macro-invertebrate surveys
Unnamed WE Creek	MSG-16	1 year of pre-construction water quality monitoring and macro-invertebrate surveys

Prepared by: DRD
Checked by: KKB

Biological Resources

Comment #64:
EIA, Volume IIG, Appendix E, Section 2.3.2: Was there consideration of sampling for baseline levels of PAHs (polycyclic aromatic hydrocarbons) or PCBs (polychlorinated biphenyls)?

Response to Comment #64:
A baseline evaluation of polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB) was considered during development of the Quality Assurance Project Plan and Sampling Analysis Plan (SAP). A regional assessment of the study area indicated that there were no potentially substantive historic sources of PCBs or PAHs that would necessitate inclusion of these parameters in the baseline evaluation. The chosen parameters for the baseline evaluation were sufficient to meet or exceed the requirements of Michigan Part 632.

Comment #65:
Explain why Hester-Dendy samplers were used for quantitative macroinvertebrate sampling versus other quantitative methods such as a stovepipe sampler or Surber sampler.

Response to Comment #65:
Hester-Dendy samplers were chosen for the macroinvertebrate quantitative sampling method based on baseline study plan project coordination with MDEQ staff Sarah LeSage and Gerald Saalfeld and was considered a scientifically sound sampling method during the 2008 and 2009 planning process.

Comment #66:
Provide an electronic copy of a table that combines the surface water quality data collected in the baseline studies and the macroinvertebrate data into one easy-to-read table. Include latitude and longitude decimal degree locations of sampling sites, and clearly indicate the dates and locations of data collected.

Response to Comment #66:
Surface water quality data was incorporated into a table (Table 66-1, Macroinvertebrate Data, located in Attachment 66), which summarizes all of the macroinvertebrate data.

Comment #67:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report: Explain why quantitative periphyton and algae sampling was not conducted.

Response to Comment #67:
The qualitative multihabitat sampling (QMH) method was selected over a more narrowed discrete quantitative method in an effort to obtain as complete a list as possible of periphyton/algal taxa present within the sampling reach in the sampling time available. This sampling method was also presented to MDEQ staff Sarah LeSage and Gerald Saalfeld and was considered a scientifically sound sampling method during the 2008 and 2009 planning process.

Comment #68:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report: How were the metrics noted in this section calculated?

Response to Comment #68:
See Metric Calculation Justification (Table 68-1, Algal Diversity Indices, located in Attachment 68).

Comment #69:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report Figures 18 and 20: When was the data collected at the stations across the two years? At AQ20, what is the suspected cause of the reduction of richness and cell concentrations from one year to the other in Shakey River?

Response to Comment #69:
In general, samples were collected between July and August of each year (2008 and 2009). Specific sample dates are included in Table 69-1, located in Attachment 69. ERM believes the comment specific to AQ20 was intended to reference AQ10. In addition to factors such as sample and analysis variability, river flows in the area were considerably lower in 2009 when compared to the same period in 2008. Flow of Shakey Creek was predominantly baseflow leading up to the 2009 sampling period and likely contributed to the reductions genus richness and algal cell concentration.

Comment #70:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report: If water chemistry data is available for the dates periphyton and diatom data was collected,

provide an electronic spreadsheet that includes the periphyton data and diatom data and water chemistry data.

Response to Comment #70:
Water chemistry data, provided by ERM, was added to the raw data tables (provided on CD) and located in Attachment 70.

Comment #71:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report: What list of tolerant species did Phycotech use for the calculation of the sensitive algae, sensitive diatom, and saprobity metrics?

Response to Comment #71:
The lists referenced for tolerant species, sensitive algae, sensitive diatom, and saprobity metrics is included in Figure 71-1, Test Method: Generic Diatom Indices, located in Attachment 71.

Comment #72:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report: Provide tables that include the actual numbers for the Shannon-Diversity, Alpha algal–cell concentration, Sensitive Diatoms, Sensitive Algae, Siltation Index, Salinity Index, Oxygen Index, Trophic Index, and Saprobity Index metrics to supplement the figures.

Response to Comment #72:
Raw data provided by ERM for the various metrics (provided on CD) is located in Attachment 72).

Comment #73:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report, Figure 16: What are the sampling dates for the two samples collected?

Response to Comment #73:
In general, samples were collected between July and August of each year (2008 and 2009). Specific sample dates are included in Table 73-1, Algal Sample Dates located in Attachment 73.

Comment #74:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix J, Phycotech Algae Analysis Report, Figure 28: What are potential reasons for the high salinity of Little Shakey Creek in 2009?

Response to Comment #74:
In addition to factors such as sample and analysis variability, river flows in the area were considerably lower in 2009 when compared to the same period in 2008. Flow of the Little Shakey Creek was predominantly baseflow leading up to the 2009 sampling period and likely contributed to the higher salinity index results.

Comment #75:
EIA, Volume IIG, Appendix E, Section 3.7.5, Appendix M, Pace Analytical Fish Contamination Report: Clarify what species were collected at each site, and the number and size of fish used in the composite samples.

Response to Comment #75:
Table 75-1, 2009 Fish Contaminant Sample Species and Length, located in Attachment 75, provides the species and respective lengths.

Comment #76:
MPA, Volume ID, Appendix G, Section 8.1.1: Clarify whether biological sampling, including macroinvertebrate and fish sampling, will be conducted as part of the Environmental Monitoring Plan during operations and post closure. If so, is this sampling included in the Financial Assurance estimates?

Response to Comment #76:
Macroinvertebrates, fish, and additional biological sampling will be conducted during operations and postclosure. This sampling will be detailed in a SAP which will be completed prior to operations and amended into the Environmental Monitoring Plan. Financial assurance estimates include environmental monitoring.

Comment #77:
MPA, Volume ID, Appendix G, Section 8.1.1: The permit application states that a mussel relocation project may be needed. Explain and provide evidence for the conclusion that the WWTP discharge is not anticipated to affect aquatic biota and habitats.

Response to Comment #77:
Mussel relocation may be needed due to disturbances associated with construction activities. The water will discharge to a standard apron endwall at the ordinary high water mark elevation of 683 feet msl approximately 8 feet from the Menominee River typical elevation of 680.8 feet msl. Heavy geotextile liner armed with heavy riprap will be placed from 2 feet up-bank from the river to a location approximately 2 feet into the river. This discharge design is expected to reduce discharge velocities and moderate temperature to the extent aquatic biota and habitats are not affected.

Comment #78:
MPA, Volume ID, Appendix G, Section 8.1.1: Explain why mussels may need to be relocated, and how and where they may be relocated.

Response to Comment #78:
As the project is currently proposed, direct effects to freshwater mussels may occur as a result of construction activity at either of the potential outfall locations. Due to the presence of state-listed taxa, it is anticipated that a mussel rescue and relocation program will be necessary to minimize potential impacts to the resident mussel population. A relocation plan including where mussels will be relocated to will be completed subsequent to final design and submitted to the MDEQ for approval before construction.

Comment #79:
Clarify how many sites were surveyed for freshwater mussels.

Response to Comment #79:
The mussel surveys were performed at two potential outfall locations identified in the *Freshwater Mussel Survey for Proposed Outfall* included as Appendix E-2 of the EIA. Additional mussel surveys were performed as part of the baseline surveys as shown on the figure provided in Attachment 79.

Comment #80:
EIA, Volume IIG, Appendix E-1, Section 2.2.1: Why does the dominant habitat description not match up with Tables 8 and 9? What is the explanation for the change in dominant substrates from years 2008 and 2009?

Response to Comment #80:
Tables 8 and 9 are intended to exhibit the longitudinal profile of the Menominee River AQ1 study area, including the dominant river substrates, and are not intended to describe the dominant habitat. Tables 8 through 11 are intended to be used together to portray the overall in-stream habitats available to wildlife. The differences in the dominant substrates described in Tables 8 and 9 between sampling years 2008 and 2009 could be explained by a number of reasons, including, but not limited to, variation in samplers, river height, flows, or other morphological changes. It is ERM's professional opinion that the differences in dominant river substrate between sampling years 2008 and 2009 likely are a result of significantly lower water levels in 2009. Lower water levels likely caused morphological changes along the river thalweg and caused movement of fine sediments to further points downstream.

Comment #81:
EIA, Volume IIG, Appendix E-1, Section 2.2.1, Table 18: Did ERM (Environmental Resources Management) visually verify these species as present, or does the list refer to species that should be found in that area? Clarify which aquatic macrophytes were present and their abundance.

Response to Comment #81:
All species noted within Table 18 were identified during survey activities within the study areas listed. As Table 18 suggests, all species were noted as locally common; however, a more quantitative assessment was not completed for these species. Less common occurring riparian and aquatic macrophytes were not noted.

Comment #82:
EIA, Volume IIG, Appendix E-1, Section 2.2.1: Where is the data showing the channel characteristics results (glide, pool)?

Response to Comment #82:
The data is included within the raw data sheets used during the field surveys pursuant to the Qualitative Biological and Habitat Survey Protocols for Michigan's Non-Wadeable Rivers (Merrit et al., 2003) referenced methods. The tables provided in this report summarize the data from the data sheets. These data sheets are provided in Attachment 82.

Comment #83:
EIA, Volume IIG, Appendix E-1, Section 2.2.3: Why was only 2008 sampled and not 2009 for the longitudinal profile and habitat scoring?

Response to Comment #83:
Only sample sites AQ1 and AQ2 were evaluated for habitat and morphology during the 2009 study year as it was determined comparing the reference site (AQ1) with at least one other study area (AQ2) would provide adequate data to evaluate habitat during the two-year assessment. This study planning is also consistent with Part 632 requirements which require at least one year of on-site data plus one year of regional data. Regional data was provided in the Phase I reconnaissance report. Additionally, this study plan was reviewed by MDEQ staff Sarah LeSage and Gerald Saalfeld and was considered a scientifically sound sampling plan during the 2008 and 2009 planning process.

Comment #84:
EIA, Volume IIG, Appendix E-1, Section 2.9.3: Why was only one fyke net deployed for each of the lakes (sampling stations)?

Response to Comment #84:
The three lakes (Resort Lake, East Lake, Baker) are part of the larger Shakey Lake System. The three sampled lakes are not only hydrologically connected but share adequate channels for fish migration between each lake. This connectivity was the basis for only deploying one fyke net per lake.

Comment #85:
EIA, Volume IIG, Appendix E-1, Section 3.2, page 27: Why was the sampling conducted outside the recommended holding times? Explain how affected value was "appropriately qualified."

Response to Comment #85:
Data which exceeded "recommended" holding times include moisture, total solids, and volatile solids for sediment samples collected July 31 - August 5, 2008. With only two exceptions (data from AQ6 and AQ9), the flagged data were comparable to data in which recommended holding times were met. Based on the apparent representativeness of the results and the supplemental nature of the particular analytes, no resampling was conducted. Data collected in 2009 were reflective of 2008 values thus confirming the representativeness of the data in question.

Comment #86:
EIA, Volume IIG, Appendix E-1, Table 2-4: Why were water samples collected and analyzed for AQ3 and AQ6 for 2008, but not 2009?

Response to Comment #86:
At a minimum, a reference and downstream site from each water system (Menominee, Shakey River, Shakey Lakes) were evaluated for water quality during the 2009 study year as it was determined comparing the upstream reference site with at least one other study area was sufficient to meet or exceed the two-year assessment requirements of Michigan Part 632.

Comment #87:
EIA, Volume IIG, Appendix E-1, Section 3.3.1: Why were habitat and macroinvertebrate surveys not conducted in 2009 for AQ3?

Response to Comment #87:
Only sample sites AQ1 and AQ2 were evaluated for habitat and macroinvertebrates during the 2009 study year as it was determined comparing the reference site (AQ1) with at least one other study area (AQ2) was sufficient to meet or exceed the two-year assessment requirements of Michigan Part 632.

Comment #88:
EIA, Volume IIG, Appendix E-1, Section 3.7.1: Why was one year of data collected by electrofishing and seining by ERM? What was the electrofishing time for AQ1 and AQ3? Why was one seine performed in AQ1 and two in AQ2 and AQ3, and what is the justification for the comparison between these sites?

Response to Comment #88:
Requirements of the baseline study included two years of relevant information, one of which needs to be site-specific data. Regional data collected by Wisconsin Department of Natural Resources (WDNR) on the Menominee River and Michigan Department of Natural Resources (MDNR) derived data from the Shakey Lakes were used to satisfy the two-year requirement. Electrofishing time for AQ1 was 61 minutes and 43 minutes for AQ3. The AQ1 sample location was located upstream of the White Rapids Dam and the water depth combined with excessive submerged macrophytes restricted areas suitable for use of a seine. Station AQ1 (reference site) was the closest location upstream from the Project Area (approximately 12 river kilometers) that was not artificially altered by dam development (i.e., highly variable stream flows at the base on the White Rapids Dam or impounded water conditions between the White Rapids and Chalk Hill Dams). Station AQ2 was chosen for its close proximity to the Project Area (adjacent to station) while Station AQ3 was chosen due to its location downstream from the Project Area and the Shakey River confluence with the Menominee River.

Comment #89:
EIA, Volume IIG, Appendix E-1, Section 3.7.1, Table 29: On page 42, it is written as data collected by Wisconsin Department of Natural Resources (WDNR) in 2003, 2005, and 2006, but the actual table is titled "2003, 2005, and 2009." Clarify the years that data was collected by WDNR.

Response to Comment #89:
The Table 29 title is incorrect and should state "WDNR Electrofishing Results for the Menominee River Near Bear Point for 2003, 2005, and 2006 Back Forty Project."

Comment #90:
Provide raw data for all fish community data collected, including lake sturgeon.

Response to Comment #90:
The 2008 and 2009 Fish Data Sheets, provided by ERM, are included in Attachment 82.

Comment #91:
EIA, Volume IIG, Appendix E-1, Section 3.7.3: How many net nights for the fyke nets?

Response to Comment #91:
One net night per lake.

Comment #92:
EIA, Volume IIG, Appendix E-1, Native mussel surveys at selected sites: Was water quality or flow data recorded during the surveys? If so, please provide.

Response to Comment #92:
Neither water quality or flow data were collected during the mussel surveys; however, USGS flow data is likely available for those approximate survey dates, which can be provided, if desired. Additionally, ERM did collect flow and water quality data at periodic intervals throughout the study period as referenced in the EIA.

Comment #93:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Dr. Auer considers spawning size of lake sturgeon to be 114 cm while Sloss and Kittel consider a lake sturgeon over 100 cm to be spawning size. Explain the difference in length of maturity and if this impacts the analysis of the adult population in this reach.

Response to Comment #93:
In the Sloss and Kittel (2007 Project Completion Report) on page 9 line 9, these authors state "All individuals greater than 100 cm were considered potential adults." They do not state where this cut off is derived from nor what sex or total length (TL) or fork length (FL) - total length at maturity differs by sex. Dr. Auer, who works with a free-ranging, non-harvested population of sturgeon in the Upper Peninsula of Michigan, has found with over 20 years of catch data of lake sturgeon at spawning time that males are mature at about 108.5 cm TL and females at 128.5 cm TL. Biologists know that in enclosed (reservoir) systems without outlets fish density and limited food can produce early maturation at smaller size. On page 28 of Sloss and Kittel, they show mean TL of males at 120 cm and mean TL of known females at 140 cm, so cut off could have been chosen as 100 cm to make sure they captured examined all potential adult spawners – 100 cm does not necessarily define cut off for spawning adults as they later observed.

Comment #94:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Figure 2 is described showing flow and temperature data but only flow is shown. What was the temperature at this location during deployment for 2008?

Response to Comment #94:
Only flow data is recorded at White Rapids Dam. In 2009 there was some temperature data from KOSS, Michigan (MI) (USGS site), however, it does not seem to be available any longer on the USGS site for 04066800. A site below White Rapids Dam - 04067500 near McAllister, Wisconsin does have temperature but only since 2011. Attachment 94 contains Figures 94-1 and 94-2 that provide a water temperature plot containing the temperature data for the MSG-14 2008

and 2009 data. If spawning occurred in late April in 2008, water temps were probably close to 10°C, the same is true in 2009 by early May temps were about 10°C.

Comment #95:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Explain why nets were set on May 11th, as opposed to when larval drift was predicted to start.

Response to Comment #95:
In 2008 a drift study was not conducted since ERM could not predict spawning. In 2009 ERM based drift on a potential spawning that was thought to have been April 15, when temps rose to 8-10°C. ERM estimated time to hatch and then time to yolk absorption and start of drift at April 26 at earliest. Looking at the flows on 25 April flows changed from 2,800 cfs to 7,000 on April 27-28. Drift netting under such flows is dangerous and not possible. May 11th was the first opportunity ERM thought they could do that job safely at about 3,000 cfs and it was reasonable to assume that the river would still exhibit YOY lake sturgeon, if present.

Comment #96:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Explain why the site was chosen for setting the drift nets, and why no additional collection sites were chosen between the 5.5 miles and the spawning site.

Response to Comment #96:
This site was chosen for access since ERM could obtain access from property owners, river width was overall level (no big holes), and ERM could cover the river width reasonably with the three drift nets. No additional sites were selected as after those high flows ERM would have expected larvae to either be totally scowered away or just beginning drift after staying deep in gravel during those high flows. Since water flows were high, drift would happen more quickly than in a slower system. ERM began lower in system expecting to not miss drift. Drift from boats is difficult and boating in the upper section of White Rapids can be dangerous due to large boulders and few access points. It was reasonable to assume that the river would still exhibit YOY lake sturgeon, if present.

Comment #97:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: At what depth were the drift nets set? Did they encompass the entire water column?

Response to Comment #97:
Drift nets were set in the river and were 58 cm in height from bottom and were submerged below the water surface - most sturgeon larvae drift along bottom, unless up near spawning site where they have less swimming ability and can occur higher in water column due to turbulent flows. The three nets and frames were set between the depths of 60 cm and 100 cm across the river.

Comment #98:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Why was a visual survey method chosen for juvenile lake sturgeon versus other methods that have been used for juvenile surveys?

Response to Comment #98:
ERM chose a visual survey as Dr. Auer has had more experience and success with this method than small mesh gillnets. Also, there was so much plant material (Wild Celery) on the substrate that there were limited areas to place a net of any type. Lake Sturgeon are known to avoid plant material as well. Also, ERM was looking for small juveniles YOY or 1 or 2 year olds (which would swim through trap net mesh) not subadults which can be caught more readily in trap nets. Caroffino et al. 2009 (published after our work) did visual survey work day and night and snorkeling in the Peshtigo River, however, the Peshtigo is a shorter, shallower, more even bottom and homogenous substrate type river below the dam than what exists in the upper Menominee. Again, the concern was how to find fish in the considerable wild celery. The Caroffino et al. (2009) paper came out after ERM had performed field work (Abundance and movement patterns of age-0 juvenile lake sturgeon in the Peshtigo River, Wisconsin).

Comment #99:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Figure 2: How do these years compare to the long term averages for discharge of the White Rapids dam?

Response to Comment #99:
In 2008 flows followed the 85-year average pretty well except April 15 to April 28 when flows were above 10,000 cfs. In 2009 flows were just below the 17-year average and greatly below that average from April 11 to April 25 when they reached 7000 cfs (Figures 99-1 and 99-2, Menominee River Flow Data, located in Attachment 99). In both years sturgeon probably spawned in the dropping flow period but at such high discharge the river becomes too dangerous and difficult to sample.

Comment #100:
EIA, Volume IIG, Appendix E-1, Lake Sturgeon Early Life Stage Investigation: Has there been any more recent data collected on the early life stages of lake sturgeon in this stretch of river?

Response to Comment #100:
ERM contacted MDNR Fishery Biologist Dr. Ed Baker and he knows of no other larval drift work as being done in this portion of the river and ERM has not performed any since 2009.

Comment #101:
EIA, Volume IIG, Appendix E-1, Appendix D: Is there updated information on the adult population of lake sturgeon for this stretch of river, in particular population estimates, tagging/tracking surveys, evidence of natural reproduction, from 2010 to present? If so, please provide or reference.

Response to Comment #101:
To the knowledge of ERM no publications resulted from the 2008-2009 work on this project. There is a thesis by a MS student at MTU that is being edited to get into publication on work conducted on the section above the White Rapids Dam that captured adult fish for tracking below White Rapids Dam in 2012-2013. ERM has also contacted WDNR Mike Donofrio to ask for any creel data on catch of sturgeon as there is a hook and line fishery in this area but there has been no updated information provided as of the date of this submittal. Also, a report entitled *Predicted Effects of Exploitation and Length Based Harvest Regulations on Lake Sturgeon in the*

White Rapids Section of the Menominee River, Wisconsin. Isermann, D., M. Donofrio, and E.A. Baker. Isermann is at UW-Stevens Point. See Attachment 101 with additional WDNR and MDNR data provided to ERM.

Comment #102:
EIA, Volume IIG, Appendix E, Phase I Environmental Baseline Studies-Aquatic Biota, 3.1: ERM referenced procedures established in Qualitative Biological and Habitat Survey Protocols for Michigan's Non-Wadeable Rivers and Michigan DNR Fisheries Division: Manual of Fisheries Survey Methods II with Periodic Updates. What specific methods were used on the July and August 2007 reconnaissance surveys? In the discussion it reads "wildlife observed by sight or by other evidence." What is other evidence? During the second reconnaissance assessment, depth was recorded to be from "several feet to eighteen feet." What specifically is "several"?

Response to Comment #102:
The 2007 reconnaissance survey was only intended to gather qualitative data to be used during the study plan preparation. The MNDR manuals/methods were not used during the reconnaissance effort to collect data, but rather to collect enough initial data to assure that these referenced methods would be practical and useful. Wildlife were observed by site, sound, visual identification of footprints, and other ecological identification methods. For example, the North American River Otter was not verified by a verified otter siting, but rather by a midden left over from an otter's meal of freshwater mussels. Lastly, since the survey results for the 2007 reconnaissance survey were very qualitative in nature, no more information was recorded regarding water depths.

Comment #103:
EIA, Volume IIG, Appendix E, Phase I Environmental Baseline Studies-Aquatic Biota, 3.3: Is wild rice being considered in the aquatic habitat monitoring plan?

Response to Comment #103:
Wild rice monitoring is not included in the current monitoring plan.

Comment #104:
EIA, Volume IIG, Table 2: Update the observations of lake sturgeon under "Potential Occurrence."

Response to Comment #104:
Table 2, as referenced in the EIA comment, describes the Michigan listed species (MNFI list) from July 2007 as presented in the results of the Phase I desktop and reconnaissance assessment efforts, which was the current list at the time of the assessment. The actual balance study observations and findings are included as Appendix C and D of the *Aquatic Biota Report for Environmental Baseline Studies* included in Volume IIG, Appendix E-1 of the EIA.

Comment #105:
EIA, Volume IIG, Table 4: Under "Potential Occurrence" why are Elktoe, Slippershell, and Round Pigtoe not noted as being observed, and why is the Black Sandshell not listed? Occurrences need to be updated.

Response to Comment #105:
The occurrences presented from July 2007 were part of the Phase I desktop and reconnaissance assessment. Actual field studies and species identified are presented in Volume IIG, Appendix E of the EIA under the *Native Mussel Surveys* included as Appendix B. In addition, Volume IIG, Appendix E-2 includes additional mussel survey information included for the potential outfall locations.

Comment #106:
What measures are proposed to keep wildlife out of the CWBs?

Response to Comment #106:
The CWBs will be fenced to restrict access by mammals. If waterfowl or other birds frequent the CWBs, a hazing plan will be evaluated.

Comment #107:
Provide a plan to evaluate potential hibernacula and habitat for the northern long-eared bat in the affected area, including potential impacts from mining activities and mitigation of any impacts.

Response to Comment #107:
A work plan to evaluate the northern long-eared bat is included in Attachment 107.

Soil Erosion and Sedimentation Control Plan, Volume ID, Appendix E

Comment #108:
Figure 2-7, Erosion Control Plan Operations Phase, shows a symbol in the legend for contact water drainage ditches. Since this symbol does not appear on the map, clarification is needed as to whether drainage ditches in the contact area are proposed, and if so, Figure 2-7 needs correction with the location(s) included, preferably at an easier to read scale.

Response to Comment #108:
New Figure 108-1 in Attachment 108 shows the contact water drainage ditches within the contact area.

Comment #109:
Table 2-1 in the SESC plan shows plans to inspect soil erosion structures weekly, including basins. Table 5-8 (Monthly Schedule for Inspection and Monitoring of Mine-Related Facilities) in the MPA shows the Inspection Frequency for Storm Water and Erosion Controls to be monthly and does not include NCWBs. Provide a table that shows the proposed monitoring schedule for all mine-related facilities for both during operations and post closure that is consistent with all plans proposed in the application.

Response to Comment #109:
Inspection for soil erosion should be monthly as stated in Table 5-8. A new Table 109-1 in Attachment 109 shows the monitoring schedule for all mine-related facilities for both during operations and postclosure.

Treatment and Containment Plan, Volume IE, Appendix H

Comment #110:
Following the waste rock placement, leachate drainage material (liner) from the base of the Flotation TWRMF will be relocated to the mine pit and backfilled over the waste rock – Provide alternatives for disposal of liner material.

Response to Comment #110:
Liner material may also be disposed at a permitted solid waste landfill. Prior to reclamation of the Flotation TWRMF, Aquila will assess the disposal process for liner materials but the current plan is to place the material within the backfilled pit.

Comment #111:
Figure 4-16 – placement of contact water sump – How was placement of contact water sumps within the TWRMFs determined in the design?

Response to Comment #111:
The contact water collection sumps were situated at low points of each of the three lined areas: Phase 1 flotation TWRMF; ii) the Phase 2 flotation TWRMF; and iii) the Oxide TWRMF. This is indicated by the topographic contour layers shown for each area. The low points for each area were established based on the original ground topography in order to minimize earth work, optimize cut/fill balance, and to efficiently collect and remove leachate from the TWRMFs.

Comment #112:
Provide a plan to cover the TWRMFs if operations are temporarily idled for an extended period of time prior to final closure.

Response to Comment #112:
If mill operations are temporarily idled for an extended period, Aquila will cover tailings with waste rock.

Comment #113:
All collected drainage water will be pumped to the WWTP for treatment until the drainage flow rate decreases to the point at which alternative methods to remove and dispose of drainage water can be implemented. One such alternative method might include periodic pumping of the sumps to a tanker truck with disposal at a local WWTP. Infiltration modeling of the capped Closure TWRMF during post closure has been conducted… "Because all water draining through the Closure TWRMF during post closure will be collected and treated prior to discharge, the quality of the drainage water within the Closure TWRMF has not been modeled during post closure." Volume IIE, Appendix D-5, p. 18-19: What is the rationale for choosing not to model the quality of drainage water within the Closure TWRMF? Provide a time line for when water treatment of leachate is no longer necessary.

Response to Comment #113:
Water quality in the closed TWRMF was not modeled because water quality during that period would have lower constituents of concern than open conditions. Due to the impermeable cover placed at closure, oxygen levels in the tailings will be reduced resulting in less reactive acid rock drainage (ARD) process. Therefore, worst case condition for leachate chemical concentrations would occur during open conditions.

As presented in Response to Comment #48, leachate will be pumped and transported off-site for disposal until Postclosure Year 50 (Mine Year 61).

Comment #114:
Page 28, "The reconfigured Oxide TWRMF will be capped with a composite cover, reclaimed, monitored, and maintained for a period of 20 years." What is the rationalization for the proposed time line of 20 years to monitor and maintain the closure TWRMF?

Response to Comment #114:
As stated in Response to Comment #48, leachate from the TWRMF will be trucked off-site for treatment until Postclosure Year 50. As such, monitoring and maintenance activities for the TWRMF leachate collection system will continue until Postclosure Year 50.

Comment #115:
Table 5-1, Contact Water Basin Design Criteria: Mine groundwater inflow pump rate is not included as an item on this table, yet it is listed in the summary in Section 5.2. For consistency, clarification is needed as to whether groundwater inflow was taken into account in the CWB design.

Response to Comment #115:
Groundwater inflow to the mine was taken into account in the CWB design. A constant groundwater inflow rate of 55 m^3/hr (242 gpm) was applied to the CWB water balance for the duration of the seven years included in the CWB design model.

Comment #116:
Table 7-1: What is the total capacity of the pit based on the design criteria? Was the addition of buffering material taken into account in the mine pit backfill and closure TWRMF design criteria? If so, how?

Response to Comment #116:
As presented in the Treatment and Containment Plan for Tailings and Waste Rock, Volume IE, Appendix H, approximately 20.8 million cubic meters (M m^3) of material will be backfilled into the pit. As noted in Response to Comment #2, the addition of 17,275 m^3 of high calcium limestone is less 0.08% of the overall backfill capacity and, therefore, is insignificant to the pit backfill design capacity.

As noted in Response to Comment #2, the addition of buffering material to the Oxide and Flotation TWRMFs during operation will not affect the facility design. The addition of buffering material to the TWRMFs during operations will also not have an impact on the Closure TWRMF design criteria.

Comment #117:
Water Management Plan: Miscellaneous flows were not taken into account for the CWB design, including truck wash and ore stockpile return, as these flows balanced to produce a net flow rate that was negligible compared with the main flow components. What is the total projected miscellaneous flow?

Response to Comment #117:
The miscellaneous flows include vehicle wash (5 m^3/hr average annual) and utility water (5 m^3/hr average annual). When factoring in return flows from the CWB back to these sources, the net summation of these flows equals approximately 1 m^3/hr to the CWB. In addition, approximately < 1 m^3/hr will be sent to the CWB from the ore stockpiles.

Comment #118:
Water Management Plan: The pump rate (195 gpm) from the pit was determined for the model based on an iterative process, with consideration given to minimizing both CWB size and ponding duration in the mine. A maximum allowable ponding duration in the pit will be established in the future based on the current pit development conditions (during operations). Is this flow rate projected to be the maximum flow rate from the pit during operations? How was this flow rate determined?

Response to Comment #118:
The pump rate of 195 gpm used in the CWB water balance was selected to minimize ponding duration in the mine pit while attenuating flows to minimize the CWB size. This pump rate accomplished these objectives for the specific water balance inputs used in the CWB design. It is likely that actual pumping rates will be higher than 195 gpm for short durations, based on actual conditions observed in the field. Pumping rates from the mine pit will be determined based on the current CWB ponding depth and available freeboard, as well as ponding depth in the pit.

Comment #119:
Water Management Plan: Groundwater inflow into pit from the groundwater model was determined to be an average annual rate of 242 gpm. Does this take into account the construction of a cut-off wall?

Response to Comment #119:
The 242 gpm pit inflow rate was developed using an analytical model of groundwater inflow to the pit prior to finalization of the numerical groundwater flow model. The analytical model did not incorporate the cut-off wall. Results from the numerical groundwater flow model that incorporate the cut-off wall indicate pit inflows will range from 55 to 197 gpm. The 242 gpm flow rate is therefore considered conservative for purposes of sizing the CWB and water treatment plant.

Comment #120:
Water Management Plan: CWB max storage (ponding value) designed to be 125.4 M gal; Section 3.9, p. 17, maximum and average model output daily flow rates from the combined

TWRMFs to the CWB were 9310 gpm and 402 gpm, respectively. These flow rates are not listed in the CWB design summary. Were they taken into consideration when sizing the CWBs?

Response to Comment #120:
The 9,310 gpm flow rate from the TWRMF occurred in response to the 100-year storm event, which was applied in Mine Year 4. This event is identified on Figure 3-4 of the Water Management Plan. The peak flow rate from the TWRMF was not, however, routed directly to the CWB. Rather, it was routed to the pit and then pumped from the pit to the CWB at a lower flow rate of 44.3 m^3/hr (195 gpm). Using the pit to temporarily store peak flows serves to enable a more reasonably-sized CWB. The average daily flow rate from the TWRMF of 402 gpm is the average of daily TWRMF discharges over the course of a year. The 402 gpm value was not an input to the CWB sizing calculations. Rather, the actual daily flow rates from the TWRMF, which vary due to varying rates of precipitation and drainage, were used to size the TWRMF.

Comment #121:
Water Management Plan: HYDRUS model: Precipitation and evaporation were set to zero to simulate the impermeable cap on the facilities during closure, and the model run set to 20 years. Why was this duration chosen?

Response to Comment #121:
The 20-year duration was chosen since this was the anticipated operating duration of the WWTP following TWRMF closure.

Comment #122:
Section 5.4, p. 23: During the reclamation phase, flow rate to the TWRMF sumps will be monitored to determine when it would be more efficient to remove the CWBs and WWTP, and implement an alternate method to remove and dispose of water reporting to the sumps. For the purposes of the WWTP closure, leachate collection becomes de minimus in post closure Year 6 (Mine Year 17). At this time, the WWTP will be removed from service. Leachate generation during the remaining period of post closure will range from 4.0-0.76 m3/hr (17.5-3.4 gpm). This quantity of leachate will be managed via pumping into tanker trucks and transporting to a local WWTP for disposal or will be treated through an alternative on-site treatment process. How long is water treatment of leachate predicted to be necessary beyond the proposed 20 year post closure period?

Response to Comment #122:
See Response to Comment #113.

Comment #123:
Table 4-3: Explain how the disposal quantity volumes were calculated, including any swell factors that were applied.

Response to Comment #123:
The volumes in Table 4-3 are based on the tonnages reported in Table 4-1. Golder (2009) determined the specific gravity of the tailings particles to be 3.96 and the average deposited tailings mass void ratio to be 0.72 resulting in an averaged deposited tailings mass dry density of

2.3 tonnes per cubic meter. In this case, the resultant "swell factor" for both tailings streams is equal to the predicted void ratio, and is therefore 72%.

Golder determined the specific gravity of the waste rock particles to be 2.7 and the average void ratio to be 0.30 (compacted, in-place) resulting in an averaged deposited tailings mass dry density of 2.08 tonnes per cubic meter (compacted, in-place). In this case, the resultant "swell factor" for the waste rock is equal to the predicted void ratio, and is 30%.

The volumes for the waste streams were calculated using the following equation:

$$Volume\ (cubic\ meters) = \frac{Tonnage\ (tonnes)}{Dry\ Density\ (tonnes\ per\ cubic\ meter)}$$

Reference:

Golder Associates, 2009. *Review of Tailings Disposal Issues, Avalon Project*. June 26, 2009. Submitted to Hudbay Minerals.

Comment #124:
Explain how the proposed design of the TWRMFs meets the requirement of having a leak detection system. How will leaks be mitigated if detected? Drainage gravel and pea stone are to be used in the leachate collection system and as a protective layer over the HDPE liner system. Explain how the granular materials to be used will be demonstrated to be non-reactive with the leachate generated from the tailings and waste rock.

Response to Comment #124:
The design meets the requirement of Michigan's Nonferrous Metallic Mining Regulations R 425.409 (a) (i) (D) that specifies that storage facility shall have a leak detection system. The proposed leachate detection system for the TWRMFs includes a leachate detection sump located below the leachate collection system sump. The design of the leachate collection system demonstrates that less than 1 foot of leachate buildup will occur on the base liner system. Therefore, leakage through the floor areas of the TWRMFs can be expected to be extremely slight. The leak detection system is provided where the leachate head levels would be greatest, that being in the leachate collection sumps. Consequently, the greatest potential for leakage through the liner system would occur in the leachate collection sumps. The leak detection system will be constructed beneath each leachate collection sump. The leak detection system will include a side slope riser at each sump having pressure transduced installed to monitor the presence of liquid in the sump. Liquid present in the leak detection sumps will be pumped to the leachate conveyance system reporting to the CWBs.

Aquila will select materials that will be non-reactive to leachate. Because of the buffering material that will be added to the TWRMFs during operations (Response to Comments #2 and #192), leachate is expected to have an approximately circumneutral pH. The leachate collection drainage stone and pea gravel used in the leachate collection system will be specified as granitic type material with minimal reactivity to leachate.

Comment #125:
Appendix B GCL/Clay Equivalency Analysis: The equivalency analysis using Darcy's Law determined that in order for a geocomposite clay liner (GCL) to attain required hydraulic conductivity of three feet of 1 x 10(-7) cm/sec clay specified in Rule 409(a)(i)(A), the GCL must have a hydraulic conductivity of 3.0 x 10(-9) cm/sec. However, manufacture specifications for this material is states the hydraulic conductivity of GCL is 5 X 10(-9) cm/sec. The report states that the lower conductivity is "achievable with a GCL based on manufacturer's data and independent testing." Please explain how you will demonstrate that the necessary hydraulic conductivity will be attained. The calculations in the help model also rely on achieving the 3.0 x 10(-9) cm/sec standard.

Response to Comment #125:
The liner equivalency calculations using the HELP model (geocomposite clay liner [GCL] having a hydraulic conductivity of $3x10^{-9}$ cm/sec) demonstrated that a GCL liner system will have approximately 50% less leakage for average peak daily conditions as compared to a clay liner system. Assuming a clay liner leakage rate of 0.000012 inches per unit area, a GCL having the same leakage rate would have a hydraulic conductivity of $6 x10^{-9}$ cm/sec, considering a 50% decrease in leakage compared to the clay liner system. Manufacturers typically report GCL hydraulic conductivity values of $1\text{-}3x10^{-9}$ cm/sec with low ion strength liquids. As part of the liner construction quality assurance (CQA) process, representative samples of GCL material will be tested to verify the saturated hydraulic conductivity of $3x10^{-9}$ cm/sec can be met.

Comment #126:
Appendix G: Construction Quality Assurance Plan: The DEQ recommends the following additions to the CQA Plan:

- *A notation that proposed deviations from the approved construction plans and specification should be approved by the DEQ prior to implementing the changes.*
- *Section 3. 2- Establish an acceptable standard for foundation grading to ensure that the foundation is prepared in accordance with design grades.*
- *Restrict use of vehicles on geomembrane materials.*
- *The CQA plan states that it will be consistent with the requirements of Rule 921 of the Part 115 administrative rules, the final version of the CQA plan should spell out all the appropriate requirements in detail.*

Response to Comment #126:
The above will be added to the Construction Quality Assurance Plan.

Reclamation Plan, Volume IE, Appendix J

Comment #127:
After the pit is backfilled it is estimated to take 22 years to naturally flood the pit. Twenty years of post closure monitoring after completion of backfill is currently proposed in the Environmental Monitoring Plan. Part 632, Rule 407 states "The post closure monitoring period shall be 20 years following completion and approval of reclamation…" Section 4 of the Reclamation Plan states "Monitoring for approximately 20 years following completion and

approval of reclamation." How does the proposed schedule meet the requirements of Part 632 for post closure monitoring?

Response to Comment #127:
Reclamation of the mine pit (backfilling and capping) will be complete in Mine Year 11. Postclosure monitoring for the mine pit will begin after approval of the pit reclamation and continue for a period of 20 years, Mine Year 31. Aquila can accelerate the flooding of the pit such that complete flooding of the pit is accomplished within 20 years by adding water from the fresh water supply wells or by adding treated water from the WWTP.

Comment #128:
Phase 4 is designated "final reclamation" in Table 2-1 and "post closure reclamation" in Table 2.2 (Mine Year 16-17). What is the difference between "final reclamation" and "post closure" reclamation?

Response to Comment #128:
Final Reclamation and Postclosure Reclamation refer to the same closure actions. A new Table 128-1 in Attachment 128 correctly identifies Postclosure Reclamation.

Comment #129:
What measures will be in place to ensure that the liner of the flotation TWRMF will not be compromised, or leachate will not be released to the environment, during backfill of the pit and the transfer of remaining waste material to the oxide TWRMF for final closure?

Response to Comment #129:
Prior to backfilling the mine pit, Aquila will prepare detail procedures for the backfilling process such that flotation leachate will be not be released into the environment during the backfill process. Waste rock removal will commence at southern end Phase 2 of the flotation TWRMF. During the waste rock removal process, flotation tailings will be transported to the Oxide TWRMF. Flotation tailings removal will begin in the southern most cells and progress to the north. During tailings transfer, the leachate collection sumps in Phase 2 will remain operating to keep leachate at the lowest possible levels. The entire Phase 2 liner system will remain intact until all the waste rock and tailings have been completely removed. Once that has been accomplished, the leachate collection drainage material will be removed and transported to the pit and used for backfill. After the complete removal of the leachate collection system, the underling liner system can then be removed. The Phase 2 liner removal will progress from south to north through the western cells and east to west through the eastern cells. The removed liner system will be transported for disposal in the pit or be transported off-site for disposal at a permitted landfill.

Comment #130:
Section 3.5.4, page 7 - "Limestone or other acid buffering material will be added to the backfill plan based upon subsequent geochemical test work planned by Aquila." – How will this affect volumes of material going into the pit?

Response to Comment #130:
The impact of limestone addition to the backfilled pit on the backfilled pit volumes is provided in Response to Comment #2 and Response to Comment #116.

Comment #131:
Section 3.5.6 – Will the River Road be rerouted for through traffic during operations? Will the River Road be routed through the site after closure for public use? If so, include plans for reclamation of the River Road.

Response to Comment #131:
Presently Aquila is working with the County to determine the status of River Road during mining operations. Plans for relocation of the River Road are not part of this application.

Comment #132:
Explain the reasoning for backfilling the pit with waste rock to 1 meter below the low groundwater elevation, including justification as to how this will control potential acid generation.

Response to Comment #132:
Flooding of the backfilled pit arrests any additional weathering and acid generation of backfilled waste rock, the pit walls, and the floor, because the maximum concentration of dissolved oxygen in the pore water is approximately 30 times less than that in atmosphere (INAP, 2009). Placing the waste rock in the backfilled pit up to an elevation of 1 meter below the low groundwater elevation ensures that the backfilled waste rock will be saturated.

Reference:
The International Network for Acid Prevention (INAP). 2009 *Global Acid Rock Drainage Guide (GARD Guide)*. http://www.gardguide.com/.

Comment #133:
Was placement of a mixture of tailings and waste rock placed into the pit considered for final tailings disposal? If so, explain why this approach was not proposed. If not, provide an analysis for this alternative.

Response to Comment #133:
Placement of tailings into the pit was considered for final tailings disposal. Due to the reactivity of the tailings, some amount of weathering product is predicted to accumulate on the tailings during operations. The release of this weathering product into pore water within the backfilled pit could potentially result in concentrations in exceedance of the groundwater/surface water interface standard. Therefore, the plan calls for conservative management of tailings in an engineered storage facility with covers, liners, and a leachate collection system where contact water can be collected and treated prior to discharge.

Environmental Monitoring Plan, Volume ID, Appendix G

Comment #134:
Provide a plan for monitoring impervious surfaces in the contact area as part of the monitoring/maintenance schedule.

Response to Comment #134:
New Table 134-1 in Attachment 134 shows the inspection/maintenance requirements of impervious surfaces in the contact area.

Comment #135:
Section 2.1.1: "…a Sampling and Analysis Plan (SAP) to be prepared as a condition of the mine permit."; "The SAP will include a Quality Assurance Plan (QAP)." – Rule 203 (g)(iii)(B)(ff) Quality Assurance/Quality Control (QA/QC) as approved by the MDEQ – shall be included as part of the mine, reclamation, and environmental protection plan. Also 203 (g)(iii)(D); Part 632 rules require the applicant to provide a QA/QC plan as part of the mine, reclamation, and environmental protection plan.

Response to Comment #135:
A *Preliminary Quality Assurance Project Plan* has been prepared and is included as Attachment 135.

Comment #136:
Provide a plan for monitoring the effectiveness and integrity of the cutoff wall.

Response to Comment #136:
See Response to Comment #30.

Comment #137:
Provide an explanation as to how the proposed list of monitoring parameters, and the proposed target detection limits in Table 2-1 was determined. Specifically, why was cobalt, uranium, vanadium, hardness, radium, volatile organic chemicals, acrylamide, and any other organic chemical used in the mineral processing area, excluded from the list? Also, please explain why method detection limits for some analytes are greater than ½, or in two cases at the Michigan Part 201 Residential Cleanup Criteria value, instead of at a lower value that allows for assessment of potential impact prior to the criteria being reached or exceeded.

Response to Comment #137:
The proposed list and detection limits were developed based on the detected analytes and target detection limits from the analysis of samples from the baseline studies. A SAP will be prepared as a condition of the mine permit and may include additional analytes. The SAP will also identify the laboratories which will be used with revised target detection limits based on the analytic methods used.

Comment #138:
Will the annual assessments of flora, fauna, fish, and wildlife habitats and biodiversity follow the same protocol as the baseline studies?

Response to Comment #138:
The annual assessments for flora, fauna, fish, and wildlife habitats will follow the same protocol used as the baseline studies. Alternative protocols may be proposed but will only be used if approved by MDEQ.

Comment #139:
Section 9.2, Post Closure Groundwater Monitoring Plan: "…leachate wells LW-12S and LW-12D will be installed in the closed pit area…"; Figure 9-1 shows wells labeled CW-12S and CW-12D located in the backfilled pit area. Clarification is needed as to whether the wells in the figure are the wells referenced in the text in Section 9.2. What is the difference between 12S and 12D in terms of the hydrostratigraphic zones proposed to be monitored?

Response to Comment #139:
The referenced text should read "compliance wells CW-12S and CW-12D will be installed in the closed pit area…" as labeled correctly on Figure 9-1. Compliance wells CW-12S and CW-12D are installed in the backfilled pit and are not intended to monitor different hydrostratigraphic zones. Compliance well CW-12S will be screened in the upper 20 feet of saturated material and compliance well CW-12D will be screened 80 to 100 feet below the elevation of the phreatic surface.

Comment #140:
Section 9.4: What environmental monitoring is planned during mine years 8-10 (reclamation activities)?

Response to Comment #140:
Mine Years 8-10 occur while the mine is operating. Monitoring for groundwater, wetlands, surface water, flora, fauna, fish, and wildlife habitats will be performed during the operational period as detailed in the Environmental Monitoring Plan.

Comment #141:
Table 6-1: What is the definition of a major storm event?

Response to Comment #141:
A major storm will be defined as one half of the 1-year, 24-hour storm event or 1 inch in 24 hours.

Contingency Plan, Volume IE, Appendix J

Comment #142:
It is mentioned that high-cal limestone could be added as an additional measure to offset the formation of acid leachate. In other parts of the application, it is proposed that some type of buffering material will be added to the pit backfill and/or TWRMF(s), with limestone as a

possibility. Water quality was modeled to take into account a buffering amendment. Why is the addition of limestone amendment included as a contingency if it has been determined that acid leachate from waste will most likely form?

Response to Comment #142:
The MPA, Volume I, states that a plan will be generated to improve water quality within the Flotation and Oxide TWRMFs so leachate that reports to the sumps is approximately circumneutral pH. Section 5.2.3 of the Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Appendix D-5, states that water quality will be improved in both TWRMFs so leachate is at an approximately circumneutral pH. The current primary option proposed is limestone addition; however, other potential options have been proposed and may be evaluated as the project moves forward. Should water quality be improved through one of the alternative options or a combination of multiple options, limestone amendment could then serve as an additional contingency measure to offset the potential formation of acidic leachate.

Comment #143:
Provide a risk analysis for a flood that inundates the mine area. Explain what contingencies will be in place if the mine area is flooded.

Response to Comment #143:
A flood frequency analysis for the Menominee River was conducted and is presented in Attachment 143. The analysis shows that the risk of a flood of sufficient magnitude to exceed the banks of the river in the Project Area is exceedingly small. Flood stage is shown to be 215 meters above mean sea level (m amsl) before Project Area inundation occurs. The return period for a flood large enough to reach a flood stage of 215 m amsl adjacent to the Project Area is shown to be in excess of 100,000 years. This means there is less than a 1 in 100,000 chance of a flood inundating the site in any given year. Conservatively, assuming a smaller and more frequent event, namely the 10,000-year event, has sufficient stage elevation to inundate the site, the probability of inundation over an assumed 50-year Project life is found to be very small at 0.5%. The 50-year Project life was chosen to include a conservatively long assumed duration for project construction, operation, reclamation and postclosure monitoring.

Summarizing:

- The probability of a flood event large enough to inundate the Project Area in any particular year is less than 1 in 100,000. Events of this extremely low probability are commonly referred to as “act of God” events.

- The probability of a flood event inundating the site once in a 50-year period is less than 0.5 in 100.

- If a flood of sufficient magnitude to inundate the site did occur, the extent of the flooding would be enormous, affecting residential properties, municipalities, industries, and virtually all properties along the entire Menominee River and vicinity drainages.

If a flood of sufficient magnitude to inundate the site does occur, Aquila would undertake several protective measures to protect infrastructure and minimize mine materials from being mobilized by flood waters. These measures include:

- Armoring of overburden and topsoil stockpiles with waste rock to minimize erosion.
- Removal of reagents and related chemical processing compounds from the Mine Site and transport to safe storage.
- Suspension of operations and drawdown of CWB volumes to reduce the volume of contact water subject to mixing with flood waters.
- Other measures as deemed appropriate.

Details of the frequency analysis are provided in Attachment 143.

Comment #144:
How will groundwater impacts from potential leakage from the CWBs be evaluated?

Response to Comment #144:
As noted in the Environmental Monitoring Plan (amended via Response to Comments #44 and #45), monitoring wells LW-4, CW-8, CW-9, CW-10, and CW-12 will all serve to detect constituents contained in the event of leakage from the CWBs.

Comment #145:
Stockpile liner failure: How will the stockpiles be lined? Is this referring to the OBA (Ore Blending Area)?

Response to Comment #145:
The overburden and topsoil stockpiles will not be lined. The OBA will have a 12 inch thick concrete pad to prevent ore from contacting ground surface.

Comment #146:
Where will monitoring devices be installed to notify staff of abnormal water levels at the OBA?

Response to Comment #146:
Water monitoring level devices will be installed in the OBA contact water collection sump. A high level beacon will be placed near the sump to notify operations of potential high water within the sump. If high water levels are detected, operations will implement a contingency plan pumping water to the pit, if needed.

Comment #147:
Section 2.1.4, covered oxide and flotation ore stockpiles: Is the concrete pad sloped to a sump described under the mitigation of risks the same sump described for the OBA?

Response to Comment #147:
The covered oxide and flotation stockpile areas do not include a contact water collection sump. The small amount of contact water which could be present in this area will drain to perimeter drainage ditches which report to the CWBs.

Comment #148:
How will monitoring of the integrity of the cutoff wall before and after blasting events be accomplished?

Response to Comment #148:
See Response to Comment #30.

Comment #149:
What contingencies will be in place if the cutoff wall is determined through performance monitoring to be ineffective for its intended purpose?

Response to Comment #149:
See Response to Comment #30.

Comment #150:
Will the fuel storage area be monitored for groundwater impacts?

Response to Comment #150:
See Response to Comment #35.

Comment #151:
What are the potential impacts to facilities of ground seismic vibrations from blasting, including the cutoff wall, if any?

Response to Comment #151:
Blasting induced ground vibrations are not expected to have any impact to project facilities. Many of the structures used for mining operations will be modular-type structures that can accept some level of ground vibration. Prior to mine development, Aquila will develop a blast monitoring program that will define allowable seismic vibrations for structures surrounding the pit. If necessary, Aquila will position seismic monitors near critical structures, such as the mill building, administrative building, wastewater treatment building, and others deemed critical to the facility operations to monitor seismicity near these structures.

Seismic vibrations for impact to the cut-off wall and mitigation measures are presented in Response to Comment #30.

Comment #152:
What is the potential risk to the environment or public health from damage to facilities from severe thunderstorms or tornadoes, and what are the proposed response measures?

Response to Comment #152:
Thunderstorms can damage facilities by lightning, strong winds and/or hail. Potential thunderstorm damage to the facility focuses on loss of power, a mine or surface area fire, and structural damage. The Contingency Plan (MPA, Appendix J) summarizes potential scenarios that show the effects and outcome of power loss and fire are limited in duration and affected area, well within the project boundary. The facility is designed with engineering controls and practices such that environmental effects should be contained. For example, power outages are backed up by a generator to support core operations with focus on safety and containment. Risk to public health by environmental damage is therefore also minimized.

Structural damage, which can be an effect of both thunderstorms and tornadoes, can occur on-site similar to any other location and facility. Thunderstorm damage from likely winds are addressed in the design of buildings and structures, which by code and standard are designed for carefully considered wind velocities. Risk to the environment and public health are negligible, therefore, no specific structural damage response measures are proposed.

Tornadoes on the other hand, are too intense and unpredictable to incorporate into designs and controls. Personnel safety in a tornado scenario is the only planning that will be in place at the site. Should a tornado touchdown on the facility, there are no specific predictions or tornado response plans focused on the environment or public health. A general emergency response plan and communication with local emergency response personnel will be in place prior to operations.

Comment #153:
Section 3.3: The River Road, which is located along the west side of the pit, will be temporarily closed during scheduled blasting within the pit in the vicinity of the road. Other parts of the application imply that the road will be closed to the public through the mine area during operations. No plans were offered to divert the road around the pit or the mine area, and all figures in the application depicting the development plan show the River Road as "ending" at the pit. The contingency plan implies this road will be open. Clarify what is to become of the River Road during operations and post closure.

Response to Comment #153:
As mentioned in Response to Comment #131, Aquila is presently working with the County to determine the status of River Road during mining operations. The relocation of River Road is not part of this project.

Financial Assurance, Volume IE, Appendix K

Comment #154:
Table 2-1, post closure monitoring activities: Requests to reduce environmental monitoring during the post closure period cannot be approved prior to completion of reclamation. Provide a cost estimate for quarterly groundwater and surface water monitoring at all proposed monitoring locations for the complete list of analytes, and flora and fauna monitoring throughout post closure monitoring for end of LOM operating period.

Response to Comment #154:
Table 154-1 has been revised accordingly as shown below in Table 154-1. The postclosure monitoring period was also extended to Mine Year 50 based on the time required to treat contact water effluent from the Closure TWRMF. The costs have been adjusted to reflect these changes which increased the postclosure monitoring and maintenance cost for the Life of Mine estimate from $9.0 million to $10.0 million.

Table 154-1
Postclosure Monitoring Actions

	Mine Years 9 through 16 (Phase 1)	Mine Years 17 through 50 (Phase 2)
Groundwater Monitoring Wells 16 GWMWs around Open Pit and Oxide TWRMF	GWMWs Quarterly	GWMWs Quarterly
Groundwater Monitoring Wells 4 GWMWs around CWB and Flotation TWRMF	GWMWs Quarterly	GWMWs Quarterly
Surface Water Monitoring Locations 17 SWMLs	SWMLs Quarterly	SWMLs Quarterly
Air Quality Monitoring	AQM Semiannually	None
Flora and Fauna	F&FM Annually	F&FM Annually
Abbreviations:		Prepared by: MJV2
AQM = air quality monitoring		Checked by: JOS
CWB = constructed wetlands basin		
F&FM = flora and fauna monitoring		
GWMW = groundwater monitoring well		
SWML = surface water monitoring location		
TWRMF = Tailings and Waste Rock Management Facility		

Comment #155:
What is the estimated length of time it will take to complete reclamation at end of construction? (3 years for end of LOM)

Response to Comment #155:
As shown on Figure 2-1 in the Reclamation Plan, reclamation at the end of construction will be complete in Mine Year 2.

Comment #156:
Since River Road Reconstruction is a line item in the Reclamation and Cost estimate, provide the plans for this reconstruction as part of the reclamation plan.

Response to Comment #156:
As discussed in Response to Comment #131, reclamation of River Road is not part of this Project.

Comment #157:
Explain the reason for the difference between the end of construction and end of LOM quantities (and therefore cost estimates) for the onsite facility access roads and the onsite maintenance roads.

Response to Comment #157:
The financial assurance cost estimates for roads at the End of Construction (EOC) and Life of Mine (LOM) are shown in Tables 157-1 and 157-2 below, respectively. The estimated quantities for the on-site facility access roads decreases from 1,590 meters in the EOC estimate to 1,370 meters in the LOM estimate. The financial assurance estimate for the on-site maintenance roads decreases from 4,900 meters in the EOC estimate to 3,000 meters in the LOM estimate. The decreases are a result of the reclamation of the Phase 2 Flotation TWRMF area, and associated roads, which is completed at the end of Mine Year 10. Access roads required for postclosure maintenance activities will remain.

Table 157-1

End of Construction Financial Assurance Estimate for Roads

1) Roads					
East Access Road	Allowance	$20,000	1	$20,000	Infrastructure Data
On Site Facility Access Roads	lin.m	$77.91	1,590	$123,881	Infrastructure Data
Phase 1 On Site Maintenance Roads	lin.m	$77.91	1,900	$148,034	Infrastructure Data
Phase 2 On Site Maintenance Roads	lin.m	$77.91	3,000	$233,738	Infrastructure Data
Haul Roads	lin.m	$313.77	2,590	$812,666	Infrastructure Data

Source: Financial Assurance Plan, Appendix A.

Table 157-2

End of Construction Financial Assurance Estimate for Roads

1) Roads					
East Access Road	Allowance	$20,000	1	$20,000	Infrastructure Data
On Site Facility Access Roads	lin.m	$77.91	1,370	$106,740	Infrastructure Data
On Site Maintenance Roads	lin.m	$77.91	3,000	$233,738	Infrastructure Data
Haul Roads	lin.m	$313.77	180	$56,479	Infrastructure Data

Source: Financial Assurance Plan, Appendix B.

Comment #158:
Explain how the cost estimate for removal of impacted soils was determined for end of LOM.

Response to Comment #158:
A provisional allowance of $75,000 was made for the removal of any impacted soils that may exist as shown in Table 158-1 below. The lump sum estimate was based on an expected quantity of approximately 7,500 cubic meters, costing approximately $10.00 m^3 for disposal. This unit cost is based on professional experience and judgement in the region.

Table 158-1

Life of Mine Financial Assurance Estimate for Removals

8) Removals					
Removal of Impacted Soils	Allowance	$75,000	1	$75,000	Impacted Areas
Removal & Disposal of Regulated Material	tonne	*$1,632*	*350*	$571,200	Impacted Areas

Source: Financial Assurance Plan, Appendix B

Comment #159:
Explain how the Wastewater Treatment costs for post closure for the end of LOM estimates were determined. Was the cost of filtering wastewater and disposal of waste solids included in the estimates?

Response to Comment #159:
The unit costs for wastewater treatment during postclosure are based on professional experience and industry benchmarks. The unit costs applied to the financial assurance cost estimate are shown below in Table 159-1. Suspended solids in the leachate are expected to be minimal as natural filtration occurs as the contact water percolates through the Closure TWMRF and leachate collection system. The cost for filtration of wastewater and disposal of waste solids is included in the estimated costs.

Table 159-1

Benchmark Wastewater Treatment Unit Costs

Flow Rate (US gpm)	0.1	1	10	100
Water Treatment Cost ($/1000 US gallons)	$500.00	$150.00	$45.00	$16.00

The revised wastewater treatment costs for the LOM estimate are shown in Table 159-2 for Mine Years 9 through 50. Total expenditures range from $105,120 in Mine Year 9 to $45,727 in Mine Year 50 as shown in Table 159-2. The net present cost of postclosure contact water treatment based on a discount rate of 2% was estimated to be $1,232,131. The costs are based on the predicted leachate production rates as shown on Table 159-2.

Table 159-2

Revised Water Treatment Costs

	Year 9	Year 10	Year 20	Year 30	Year 40	Year 50	Total for Years 9 through 50	Net Present Cost Discounted at 2%
Contact water from Closure TWRMF (US gpm)	2.0	1.8	0.9	0.5	0.4	0.3	-	-
Water Treatment Cost ($/1000 US gallons)	100.0	110.0	155.0	210.0	240.0	290.0	-	-
Contact water from Closure TWRMF (x1000 US gallons)	1,051	946	473	263	210	158	14,191.20	-
Treatment Cost	$105,120	$104,069	$73,321	$55,188	$50,458	$45,727	$2,188,073	$1,232,131

Comment #160:
Explain how and why a discount rate of 2 percent was applied to post closure monitoring and maintenance for end of construction and end of life of mine estimates.

Response to Comment #160:
Discounting refers to the recognition of the time value of money in planned cash flows. The premise of the time value of money is that money in the hand today is worth more than money that will be received at some future dates. Discounting is the procedure by which cash flows are discounted to present value using an appropriate discount rate.

A risk-free discount rate is the theoretical rate of return of an investment with no risk of financial loss. One interpretation is that the risk-free rate represents the interest that an investor would

expect from an absolutely risk-free investment over a given period of time. A risk-free discount rate was selected for the financial assurance estimate to ensure that the state of Michigan is not subjected to any risk. The interest rate on government bonds are typically taken as the risk-free rate. Based on historic yields of U.S. Treasury Bills, 2% was selected, which is commonly applied for similar applications. The discount rate was applied to monitoring and maintenance costs to reduce them to present day costs. The estimates were discounted according to the following equation:

$$Present\ value\ of\ planned\ expenditure = \frac{Planned\ expenditure}{(1 + discount\ rate)^{Years\ until\ expenditure}}$$

Comment #161:
Do the financial assurance estimates take into account proper abandonment of monitoring wells? If so, specify the line item.

Response to Comment #161:
An allowance of $10,000 has been made for the installation of each monitoring well as shown in the End of Construction and Life of Mine estimates provided as Appendix A and B of the Financial Assurance Plan, respectively. This cost includes an allowance for proper abandonment of monitoring wells.

Comment #162:
What sources were used for cost estimates?

Response to Comment #162:
The financial assurance cost estimate and selected unit rates are based on professional judgement and are supported by benchmark rates in the region and quotes by contractors.

Comment #163:
Recalculate Financial Assurance estimates as necessary to reflect any modifications or adjustments in the Mining, Reclamation, or Contingency Plans based on the response to MDEQ requests for additional information or clarification.

Response to Comment #163:
The recalculated financial assurance cost estimates for the EOC and end of LOM cases are shown in Tables 163-1 and 163-2, respectively. Adjustments to the estimates include:

- Increased surface water, groundwater, and flora/fauna monitoring frequency in the LOM estimate according to Response to Comment #154. This increased the postclosure monitoring and maintenance costs by $1.0 million.

- Removal of river road reconstruction from both the EOC and LOM estimates which reduced the 'General Site Restoration' cost estimate by $765,000.

- Removal of contact water treatment costs from the EOC estimate resulting from an increased understanding of leachate generation time periods. 'Postclosure Monitoring and Maintenance' costs were reduced by $3.7 million as a result.

- Extension of the postclosure monitoring and maintenance period to Mine Year 50 in the LOM estimate which increased the 'Postclosure Monitoring and Maintenance' by $1.0 million.

- Reduced contact water quantity and treatment cost estimates resulting from an increased understanding of leachate quantities generated by the TWRMF during reclamation and postclosure. The reduction of the postclosure costs is based upon a refined estimate of leachate generation quantities at the closed TWRMF. 'Postclosure Monitoring and Maintenance' costs were reduced by $4.0 million as a result.

Table 163-1
End of Construction Period
Revised Financial Assurance Cost Estimate Summary

Task	Estimate
♦ **Reclamation**	
Mine Pit Backfilling (x $1M)	$8.8
TWRMFs (x $1M)	$2.4
General Site Restoration (x $1M)	$4.5
Buildings and Structures (x $1M)	$2.3
♦ **Postclosure Monitoring and Maintenance (x $1M)**	$2.0
Subtotal (x $1M)	$20.0
MDEQ Administrative (5%)	$1.0
Contingency (5%)	$1.0
Total (x $1M)	$22.0

Table 163-2
End of LOM Operating Period
Revised Financial Assurance Cost Estimate Summary

Task	Estimate
♦ **Reclamation**	
Mine Pit Backfilling (x $1M)	$57.2
TWRMFs (x $1M)	$21.7
General Site Restoration (x $1M)	$4.3
Building and Structures (x $1M)	$2.3
♦ **Postclosure Monitoring and Maintenance (x $1M)**	$6.0
Subtotal (x $1M)	$91.5
MDEQ Administrative (5%)	$4.6
Contingency (5%)	$4.6
Total (x $1M)	$100.7

EIA, Volume II

Comment #164:
Is the mining area, as defined in Part 632, proposed to be the entire area within the project boundary on the figures provided in the EIA? If not, provide a figure defining the mining area for the project.

Response to Comment #164:
The project boundary on the figures provided in the EIA is the "mining area" as defined in Part 632.

Comment #165:
Provide a figure (or figures) showing the affected area where the land surface, surface water, groundwater, or air resources are determined through the EIA to be potentially affected by operations within the proposed mining area.

Response to Comment #165:
The definitions of Affected Area and Mining area are provided in Part 632:
"Affected area" means an area outside of the mining area where the land surface, surface water, groundwater, or air resources are determined through an environmental impact assessment to be potentially affected by mining operations within the proposed mining area.

"Mining area" means an area of land from which earth material is removed in connection with nonferrous metallic mineral mining, the lands on which material from that mining is stored or deposited, the lands on which beneficiating or treatment plants and auxiliary facilities are

located, the lands on which the water reservoirs used in the nonferrous metallic mineral mining process are located, and auxiliary lands that are used in connection with the mining.

The affected area from the perspective of each media are discussed below. The mining area is understood for the Project to reside completely within the fence line. The fence line is shown on many MPA figures, for example, Figures 2-1 and 2-3.

Land Surface

The land surface will be directly disturbed only within the mining area, as shown by the fence line on MPA Figure 2-1. Air deposition effects may affect the land surface. EIA, Appendix I, Memorandum on Back Forty Project – Air Deposition and Water Quality Impact Analysis Figure 2 shows the deposition contours of copper out to 0.1 $mg/m^2/yr$. Similar to dispersion, deposition becomes more dilute with distance. Copper is a reasonable parameter selection to show affected area since it is a primary target metal of the mine.

Surface Water

Potential surface water effects that may develop during operations include the following:

- River and creek flow reductions from the groundwater drawdown resulting from pit excavation.
- Wetland water reduction to certain wetlands from groundwater drawdown resulting from pit excavation.
- The Menominee River mixing zone from the WWTP treated water discharge.

The groundwater drawdown is shown on EIA, Figure 3-12. Drawdown contours are shown to 0.5 meters. There are no rivers or creeks outside the mining area within the outer contour, therefore, no effects to those types of water bodies are anticipated.

Water supply to wetlands adjacent to the contours may be reduced. Further discussion of these potential effects can be found in EIA, Appendix D-11 Memorandum on Indirect Wetland Impact Evaluation.

Lastly, as with any water discharge, a mixing zone extends downstream from the discharge location, diminishing with distance until the discharge water completely mixes with the receiving water. That will be the case for the treated water discharge for the Project. The Menominee River baseflow is on average 107,000 m^3/hr. The maximum treated water discharge is 240 m^3/hr, approximately 0.2% of river baseflow. The mixing zone of the discharge is not expected to be present beyond a localized area at the outfall.

Groundwater

Potential groundwater effects during operations are shown on EIA, Figure 3-12 and include the groundwater drawdown resulting from pit excavation.

Air Resources

Air emissions have been evaluated in the Air Permit Application and have been shown to comply with applicable air quality standards, expressed in concentrations of pollutants. Air pollutants will be dispersed by air currents, becoming more dilute with distance. Contour maps of particulate matter dispersion can be found in the Air Permit Application (Appendix F, Air Quality Impact Analysis). Contours extend beyond the mining area to what can be considered as the affected area.

Comment #166:

Volume II, Figure 3-20: Reference where information regarding the average annual flux values is located in the MPA.

Response to Comment #166:

Figure 3-20 in the EIA is explained in Section 3.5.3 and fully supported in EIA, Appendix D-6 Memorandum on Aquila Site-wide Water Balance.

Comment #167:

How were samples chosen for ABA (acid base accounting) for soils?

Response to Comment #167:

Samples for acid base accounting (ABA) testing were selected to be spatially representative; sample locations were evenly distributed across the area to be developed. A secondary goal was to compare the acid-base accounting of soils overlying the mineral deposit with those elsewhere on the property.

Comment #168:

How were constituents chosen for analysis for soils?

Response to Comment #168:

The constituents selected for laboratory analysis were chosen for the following reasons: some represent major elements in typical rock forming minerals in this area, and others represent major, minor, and trace elements found in mineral deposits in the region.

Comment #169:

Paste pH data for 5 sites was analyzed for ABA – provide the rationale for choosing these 5 sites for this analysis.

Response to Comment #169:

The rationale for choosing these five sites is the same as that given for Response to Comment #167.

Comment #170:

Infrastructure – shows using River Road for transport, but no mention of fate of River Road passing through project; road fenced off south and north of project area. What are the impacts to the River Road?

Response to Comment #170:
See Response to Comment #131.

Comment #171:
Aesthetic resources Section 3.19 – During operations the River Road will be detoured to accommodate the open pit excavation. - Will a replacement road be constructed through the backfilled pit post closure or permanently rerouted/detoured?

Response to Comment #171:
See Response to Comment #131.

Comment #172:
Noise Mitigation – What time of day will blasting occur? (approximately twice per week; every 2-3 days in contingency plan)

Response to Comment #172:
Specific blasting times haven't been specified. A blasting plan detailing the timing of the blasting will be prepared prior to initiating blasting activities.

Comment #173:
How were the boundaries of the "affected areas" shown in Figure 1 determined?

Response to Comment #173:
The "affected areas" shown on Figure 1 of the Aquila Site-Wide Water Balance represent the two watersheds that encompass the entire project area. These watersheds were chosen because all project activities and water management activities will occur within these watersheds. The watershed boundaries themselves were obtained from the USGS National Hydrography Dataset (NHD) Watershed Boundary Dataset (WBD). The WBD is found at http://nhd.usgs.gov/wbd.html. The boundaries within the WBD are determined by identifying linear highpoints that define divides between surface water bodies. Data used in mapping these divides includes digital ground elevation data, surface water body spatial data and aerial photography. The boundaries are defined by the USGS.

Comment #174:
Memorandum on site-wide water balance, Vol IIE, Appendix D-6: How does the average annual precipitation from NOAA (National Oceanic and Atmospheric Administration), 2000 compare with onsite precipitation data? Is there more recent data available?

Response to Comment #174:
For water balance and related analysis, "on-site" data were not used in favor of data from NOAA-operated sites in Stephenson, MI and Dagget, MI, which are close to the Project Area. The NOAA data were chosen for use in Project analysis because these stations provided longer periods of record that contained a greater range of variability which was important to capture in an effort to provide a robust analysis. With regard to the question "Is there more recent data available"; both the Dagget and Stephenson stations remain in operation. At the time the analysis was conducted, CWB sizing was performed using the rainfall record from 1965. The 1965 record was chosen because examination of discharge records for the Menominee River

revealed 1965 to be the highest discharge year on record. To provide a conservative analysis for CWB sizing, the precipitation record for 1965 was used in the water balance model for each year. The fourth year was augmented by application of the 100-year storm. In this manner, the CWB is sized to accommodate the precipitation record that generated the highest recorded Menominee River discharge with the added conservatism provided by adding in the 100-year storm. Use of a daily precipitation record from a more recent year would yield a less conservative CWB size than that obtained from the approach used.

Comment #175:
Cumulative Impacts – The deposition of particulate matter was evaluated as a possible additive effect – What are the possible the additive effects of surface water discharge?

Response to Comment #175:
The first task in considering an additive effect from the facility surface water discharge to past, present, or reasonably foreseeable future actions is to characterize that discharge. The characterization below shows that the facility surface water discharge will have a minimal impact on the environment (the Menominee and Shakey Rivers) and, therefore, additive effects on any and all past, present, or reasonably foreseeable future actions are negligible.

Surface water discharge from the facility comes from two sources: noncontact storm water runoff to adjacent areas and noncontact sedimentation basins; and the treated water discharge. The receiving waters are the Shakey and Menominee Rivers. Section 3.5.3 in the EIA describes the site-wide water balance addressing change in flux of both groundwater and surface water as impacted by the presence of the facility. Considering the flows depicted on EIA, Figures 3-19 and 3-20, the facility effect from surface water discharges on the Menominee and Shakey Rivers are summarized in Table 175-1:

Table 175-1

Summary of Surface Water Flows and Surface Water Discharges

Surface Water Discharge Source	Baseline Flow (m^3/hr)	Project Associated Flow with Facility (m^3/hr)	Change (Baseline vs. Project)	% change
Shakey River Water Balance				
Runoff	310	310	0	
Treated Water Discharge	0	0	0	
Shakey River	2,800[1]	2,800	0	0
Menominee River Water Balance				
Runoff	200	190	-10	
Treated Water Discharge	0	150	150	
Menominee River	107,038[1]	107,178	140	0.13%

[1] Environmental Resources Management, 2011. *Hydrogeology Report Environmental Baseline Studies*, EIA, Appendix D-1).

Prepared by: AKM
Checked by: JSL

Feasible and Prudent Alternatives

Comment #176:
Mining method – preliminary assessment of underground mining showed that it is not a prudent alternative for this ore body – What is the reference for this assessment?

Response to Comment #176:
The sinking of an underground mine shaft was evaluated in the 2014 Preliminary Economic Assessment (PEA) as reported by Tetra Tech (2014). Although the ore body was found to extend downward beyond the bottom of the pit and was deemed minable via underground methods, the grades, quantity, and distribution of the ore types were not adequate to efficiently process in the oxide and sulfide plants.

Comment #177:
Ore Processing location – same location as mining, advantage of reduced transportation costs – What other ore processing sites were considered?

Response to Comment #177:
The ore process facility location was selected based upon a number of criteria: 1) To limit disturbance to wetlands and other environmental features; 2) Close proximity to the mine pit to reduce ore transportation to the mill facility; 3) Be in close proximity to the facility administration building and main entrance road; and 4) Be in close proximity to the TWRMFs to limit tailings transport distance.

Off-site ore processing facilities were evaluated for potential processing locations. However, the costs for ore shipment to off-site facilities is not sustainable for the project value.

Comment #178:
Tailings management/storage/disposal – The preferred method (co-disposal of waste rock and thickened tailings) was selected because it provided best project value with reduced storage footprint. Was the possibility of increased potential for oxidation for thickening or dry stack possibilities considered in the alternatives analysis, as opposed to conventional slurry with high water content? Was the backfilling of the tailings into the pit considered for closure, either mixed with the waste rock as much as possible, or all tailings in the pit with waste rock left on the surface? Was the possibility of offsite tailings and/or waste rock disposal considered?

Response to Comment #178:
Thickened tailings having solids content near 78% will be pump as a slurry to the TWRMFs. Because the tailings remain saturated at deposition, the potential for oxidation compared to low solids content slurry would be similar. The difference between the two deposition processes is the amount of bleed water after deposition. Dry stacking is a process where the tailings have high solids content and are managed in an unsaturated state, consequently the potential for oxidation is greater.

Backfilling of pit with tailings was considered. This process was not selected due to the higher reactivity of tailings compared to waste rock. The tailings have, by mass, a much larger surface

than waste rock, consequently having a higher reactivity potential. Therefore, it was determined to keep the tailings in the TWRMF which upon closure would provide a secure location that would limit oxygenation of the tailings reducing its reactivity. Off-site disposal for tailings is not feasible due to large cost for its transport and disposal off-site.

Comment #179:
What other locations were considered for the TWRMFs?

Response to Comment #179:
As seen on Figure 2-3 from the Treatment and Containment Plan, the Flotation and Oxide TWRMFs occupy approximately 140 and 80 acres, respectively, totaling 220 acres. The Project boundary encompasses approximately 350 acres. Consequently, Aquila does not have available other large tracts of land to use for the TWRMFs. Other configurations for the TWRMFs were evaluated. However, these other configurations all resulted in more disturbance to wetlands or other environmental features on the site. Therefore, the selected configuration as shown in the MPA provided best use of the land space, reduced wetland taking, and close proximity to the mill operations.

Comment #180:
Tailings management – de-watered tailings to 81 percent solids, around 78 percent stated in Section 5.6.4. Clarify the expected percent of solids for the de-watered tailings.

Response to Comment #180:
Golder (2010) predicted an expected slurry density of 81% solids for non-segregating thickened tailings based on their experience and test results, however, results seemed to range from 78% to 83% solids. Foth selected an average tailings slurry density of 78% solids to be conservative. The actual slurry density of the thickened tailings may vary slightly.

Reference:
Golder Associates, 2010. *Tailings and Waste Rock Management Alternatives, Back Forty Joint Venture Project*. August 5, 2010. Submitted to Foth Infrastructure &Environment, LLC.

Comment #181:
Provide an alternatives analysis comparing a dry stack (86 percent solids) to the proposed dewatering.

Response to Comment #181:
An alternatives analysis was completed by Golder (2010). High density thickened tailings were selected as the preferred method. Filtered tailings (86% solids) was rejected by Golder due to extremely high costs for dewatering and greater potential for generation of ARD. Filtered tailings are not saturated like non-segregated thickened tailings and therefore could oxidize under subaerial conditions.

Reference:
Golder Associates, 2010. *Tailings and Waste Rock Management Alternatives. Back Forty Joint Venture Project*. August 5, 2010. Submitted to Foth Infrastructure & Environment, LLC.

Comment #182:
Were alternatives considered for the use chemicals other than cyanide for ore processing?

Response to Comment #182:
Cyanide is used through the flotation process as a depressant. Other depressant additives were considered; however were rejected due to less than optimum concentrate recovery.

Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities

Comment #183:
Section 4.2.1 - The backfill will be amended with additional alkalinity to ensure pore water is buffered at a circumneutral pH.— How will this be determined?

Response to Comment #183:
See Response to Comment #2.

Comment #184:
Water quality models were also constructed to estimate water quality in the TWRMFs when amended with limestone, and backfilled pit pore water quality post closure. Explain how the limestone amendment was applied in the models, including volume ratio and surface area.

Response to Comment #184:
As described in Response to Comments #2 and #192, the effect of adding limestone was evaluated by simulating the reaction of the modeled effluent with calcite ($CaCO_3$), the primary component of limestone. The limestone amendment simulation was conducted in the REACT module of Geochemist's Workbench ® (Bethke, 2008) inputting results of mass balance models. Influent water was reacted with limestone (modeled as calcite, and assumed to be 100% reactive) until the solution was saturated with respect to calcite. Model predictions regarding necessary mass and volume of amendment required to reach saturation with respect to calcite are shown in the table embedded below for the backfilled pit, Flotation TWRMF, and Oxide TWRMF. Note that the amount of calcite reacted was on a mass basis and not on a surface area basis, as calcite was added in the models through a titration of calcite mass into the modeled solution at each model iteration. Also note that the numbers presented in the table below vary slightly from those presented in the EIA for the backfilled pit; values presented here show the minimum quantity with which to amend each facility in order to achieve saturation with respect to calcite.

Facility Model	Calcite Mass Reacted[1] (mg/L of solution)	Calcite Volume Reacted[1] (cm^3/L of solution)
Flotation TWRMF Year 2	1,218	0.459
Flotation TWRMF Year 5	2,244	0.841
Flotation TWRMF Year 7	3,859	1.433
Oxide TWRMF Year 2	0	0.000
Oxide TWRMF Year 5	249	0.092
Oxide TWRMF Year 7	497	0.185
Backfilled Pit	69	0.025

Notes:
[1] The mass and volume of calcite presented is the amount reacted per liter of solution to reach equilibrium with calcite.
cm^3/L = cubic centimeters per liter
mg/L = milligrams per liter

Prepared by: MCC2
Checked by: ASH1

Reference:
Bethke, C.M. 2008. *Geochemical and Biogeochemical Reaction Modeling*, Second Edition. Cambridge University Press, Cambridge, UK.

Comment #185:
Backfilled pit: Water quality is predicted to be neutral buffered by alkalinity from groundwater and calcite amendment to the backfill material. Explain how the calcite amendment was applied in the model, including volume ratio and surface area.

Response to Comment #185
See response to Response to Comment #184.

Comment #186:
TWRMFs: Concentration of modeled constituents increased over time; flotation tailings acidic, oxide tailings neutral to increasingly acidic. Modeling predicted that concentrations of metals will decrease significantly and pH will increase to circumneutral when they are amended with limestone, or when water quality is buffered with additional alkalinity. Explain how the limestone amendment was applied in the model, including volume ratio and surface area.

Response to Comment #186:
See response to Response to Comment #184.

Comment #187:
Section 3.2: During backfilling, the waste rock will be amended with limestone or other suitable buffer material… What types of buffering material are being considered?

Response to Comment #187:
The primary buffering material currently being considered is high calcium limestone.

Comment #188:
Section 4.2.2: The liner system that will have been installed during construction of the TWRMFs during operations will remain in place. Will the entire liner system from the flotation TWRMF remain in place? This would not be consistent with the Treatment and Containment Plan Section 4.2.2.

Response to Comment #188:
As described in Response to Comment #129, the Flotation TWRMF Phase 1 liner will remain intact after closure and be incorporated into the closure TWRMF. The Phase 2 liner system will be removed at closure.

Comment #189:
"Because all water draining through the closure TWRMF during post closure will be collected and treated prior to discharge, the quality of the drainage water within the closure TWRMF had not been modeled during post closure." What about after post closure? Will this water have to be treated in perpetuity?

Response to Comment #189:
See Response to Comment #113.

Comment #190:
Section 5.2.1 – Because it is anticipated that the pit backfill will be amended with limestone in order to ensure that pH is adequately buffered, calcite was added to the equilibrium geochemical model in order to bring the system to saturation with respect to calcite. Explain how calcite was added to the equilibrium geochemical model. How much limestone is predicted to be required to ensure that pH is adequately buffered in the pore water?

Response to Comment #190:
See Response to Comment #184 regarding how calcite was added to the equilibrium geochemical model. The amount of limestone predicted to be required in the backfill pit is discussed in Response to Comment #2.

Comment #191:
Table 5-2, Backfilled Pit Pore Water Quality Summary – It is mentioned in the backfilled pit conceptual model that the backfill will be amended with additional alkalinity to ensure the pore water is buffered at a circumneutral pH. Clarify whether an alkalinity amendment was taken into account in the model to produce the predicted water quality results presented in Table 5-2.

Response to Comment #191:
The addition of alkalinity amendment was taken into account in the backfilled pit model to produce the water quality results presented in Table 5-2. The amount of calcite added to the model is summarized in Section 4.2.1.2 of the Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Appendix D-5, and is further defined in Response to Comment #184.

Comment #192:
Section 5.2.3 - "Aquila will generate a plan to improve water quality within both the flotation and oxide TWRMFs so that the leachate that reports to the sumps is approximately circumneutral pH. This plan will be developed during the final engineering state of the Project, and submitted to the MDEQ for review and approval as part of a permit condition." Because of the implications to the design of the facilities proposed, provide a plan to improve water quality within both the flotation and oxide TWRMFs as part of the Mine Permit Application, along with an alternatives analysis for possible options, also to include water quality predictions for the Closure TWRMF at the end of the proposed post closure monitoring period.

Response to Comment #192:
The current plan for improving water quality within both the Flotation TWRMF and Oxide TWRMF is to amend both TWRMFs with high calcium limestone to buffer the pH of the leachate at approximately circumneutral. The amount of limestone that will be added is derived from the amount of calcite that was added to reach equilibrium with calcite in the TWRMFs models presented in Section 5.2 of the Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Appendix D-5, and summarized in Response to Comment #184.

The amount of amendment required at the Flotation TWRMF and the Oxide TWRMF is based on the amount required for modeled contact water to achieve saturation with respect to calcite. As was summarized in Response to Comment #2, calcite was used in place of limestone to buffer acidity in geochemical models of water quality (limestone is primarily comprised of calcite); the buffering material is assumed to be 100% reactive in the model. The geochemical model was used to predict the evolution of contact water and leachate chemistry towards equilibrium as limestone amendment is added and as secondary mineral precipitate. Outputs from geochemical modeling were further modified to account for limestone impurity and for any loss of reactivity due to surface area, contact effects, and/or the development of a passivating coating. High calcium limestone is assumed to have a purity of 98% calcite ($CaCO_3$) and reactivity was scaled to 70% to account for surface area and contact effects. These scaling factors are applied to calculate the quantity of necessary amendment per liter of leachate, and then scaled up to meet the buffering requirement for the total volume of water present within each TWRMF during each modeled time period (Table 4-10, Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Appendix D-5), summed over the time periods, and finally applying a "factor of safety" of 3, based on professional judgement. This calculation predicts that the Flotation TWRMF will be amended with 30,988 tonnes (12,395 m^3) of limestone and the Oxide TWRMF will be amended with 651 tonnes (260 m^3) of limestone. Limestone will be added to both waste rock and tailings contained within each TWRMF. The particle size of limestone amendment is anticipated to be similar to coarse to fine sand based on the Unified Soil Classification System. Moving forward in the permitting and mining process, bench scale and field scale tests will be necessary to verify or further refine the type, quantity, and particle size of buffering material to add, and also to ground-truth the best methods for adding amendment, as proposed in Section 5.2.3 of the Water Quality Models for Open Pit and Tailings and Waste Rock Management Facilities Report, Volume IIE, Appendix D-5. The exact delivery mechanism will be determined and submitted for regulatory approval during the final engineering stage of the Project, prior to construction.

Based on Flotation TWRMF and Oxide TWRMF water quality modeling during operations, a conservative assumption that all water draining through and collecting in the Closure TWRMF sumps will require treatment prior to discharge into the environment was made. As a result, the quality of water within the Closure TWRMF has not been modeled. Operations water quality monitoring data (i.e., TWRMF leachate quality data) will be used during the operation phase of the project to analyze the geochemical evolution of the Flotation and Oxide TWRMFs with a focus to model and predict the composition of water collecting in the Closure TWRMF postclosure. Additional information pertaining to the Closure TWRMF is provided in Response to Comment #189.

Cultural Resources

Comment #193:
Provide a mitigation plan for discovered archeological sites.

Response to Comment #193:
An unanticipated discovery plan has been completed to provide guidance for appropriate response in the event that any previously unknown cultural resources are inadvertently discovered during construction of the project. The unanticipated discovery plan is included as Attachment 193.

Potable Water Supply

Comment #194:
MPA, Vol 1, Section 2.2: Plan for potable and non-potable well installation in future. An additional water withdrawal assessment for additional water wells will have to be done, and a Michigan Safe Drinking Water Act construction permit, through the local health department, will be necessary for all components of the potable water supply source and treatment system.

Response to Comment #194:
It is understood that the water withdrawal assessment will have to be executed again and results submitted to MDEQ with the permit application prior to initiating construction of the pit or installation of a water supply well. This will be undertaken prior to construction.

Comment #195:
MPA, Vol 1, Section 5.7.9.4: Provide an alternative plan for treatment of potable water. Ultraviolet disinfection is not an approved process in Michigan.

Response to Comment #195:
As part of the fresh water supply for the facility, a disinfection process will be installed to provide drinking water that is safe for potable water use. Given that ultraviolet disinfection is not acceptable to MDEQ, another process such as chlorination will be selected consistent with MDEQ guidance. The process will be described in the Type II Non-Transient Non-Community Water Supply Permit Application, to be submitted to the Delta/Menominee County Health Department.

Comment #196:
MPA, Vol 1, Section 5.7.9.6: There is no mention or acknowledgement that a construction permit will be required for the on-site sanitary wastewater system. The local sanitary code of Public Health Delta and Menominee Counties requires one.

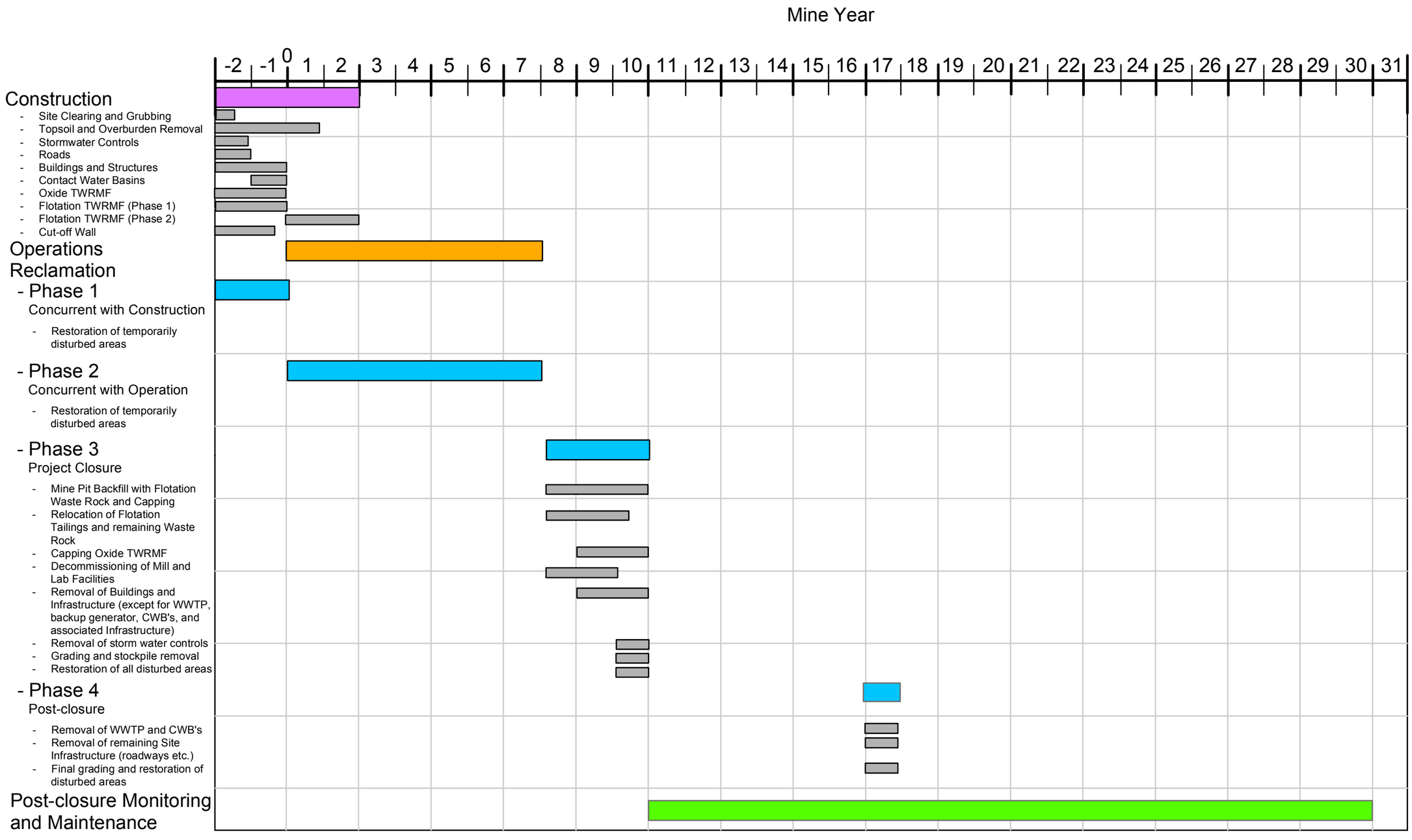
Response to Comment #196:
Aquila understands a commercial Septic System Permit will be needed if a septic system is installed for the Project. This permit is listed in Section 1.3.

Air Deposition

Comment #197:
Provide a soil deposition impact analysis.

Response to Comment #197:
Refer to Attachment 197 for the Soil Deposition Impact Analysis.

Attachment 1



NOTES
1. Timeline is approximate.
2. TWRMF = Tailings and Waste Rock Management Facility.

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
PREPARED BY: JOS1			DATE: SEP. '15	
REVIEWED BY: JSL			DATE: OCT. '15	
APPROVED BY: JOS1			DATE: OCT. '15	

BACK FORTY PROJECT

FIGURE 1-1
MINING PERMIT APPLICATION
OVERALL PROJECT TIMELINE
STEPHENSON, MICHIGAN

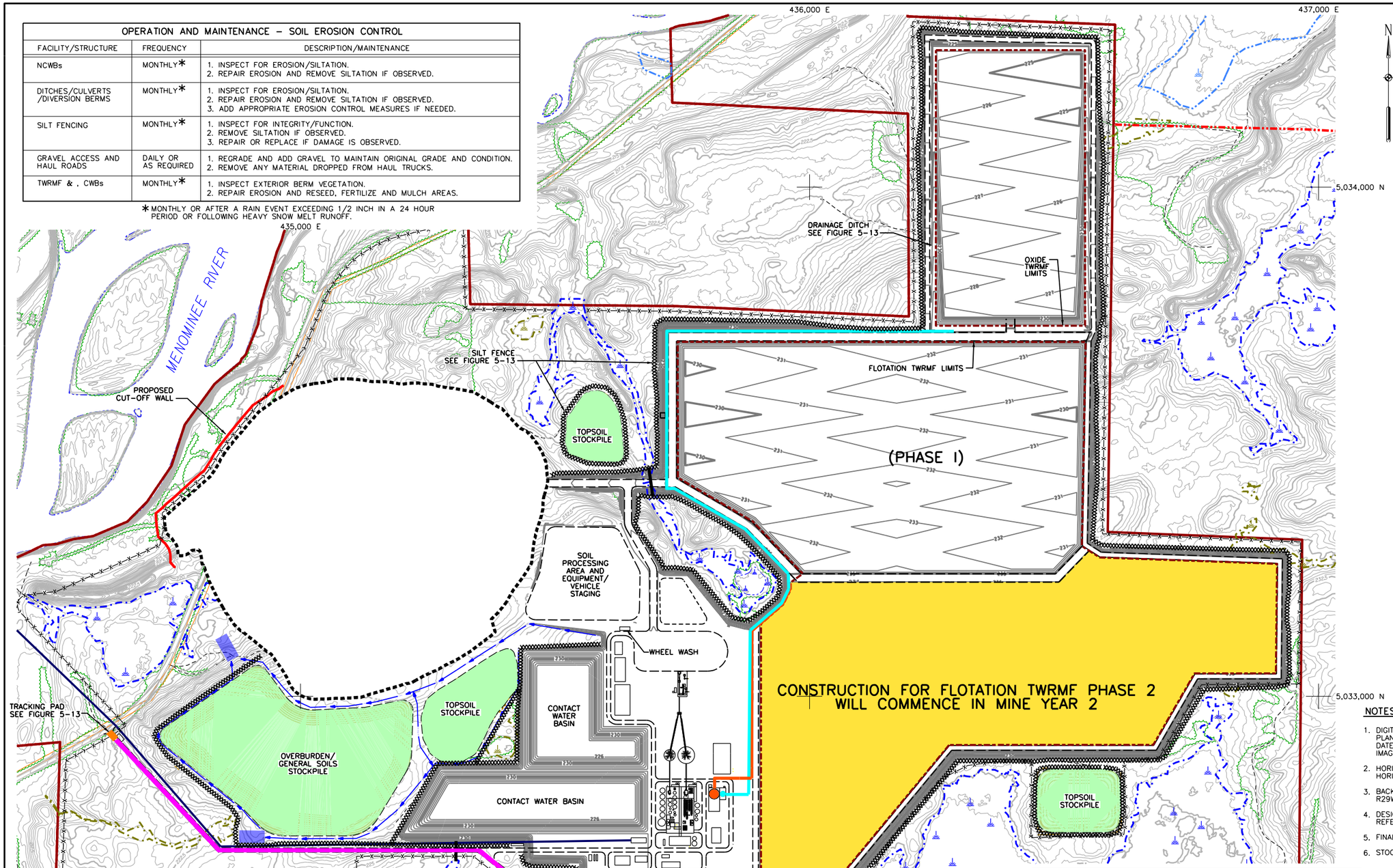
Scale:	NO SCALE	Date:	MAY 2016
Drafted by:	DAT	Project No:	14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\MPA\Response to Comments\Figure 1-1 Project Timeline.mxd Date: 5/19/2016

Attachment 6

OPERATION AND MAINTENANCE – SOIL EROSION CONTROL		
FACILITY/STRUCTURE	FREQUENCY	DESCRIPTION/MAINTENANCE
NCWBs	MONTHLY*	1. INSPECT FOR EROSION/SILTATION. 2. REPAIR EROSION AND REMOVE SILTATION IF OBSERVED.
DITCHES/CULVERTS /DIVERSION BERMS	MONTHLY*	1. INSPECT FOR EROSION/SILTATION. 2. REPAIR EROSION AND REMOVE SILTATION IF OBSERVED. 3. ADD APPROPRIATE EROSION CONTROL MEASURES IF NEEDED.
SILT FENCING	MONTHLY*	1. INSPECT FOR INTEGRITY/FUNCTION. 2. REMOVE SILTATION IF OBSERVED. 3. REPAIR OR REPLACE IF DAMAGE IS OBSERVED.
GRAVEL ACCESS AND HAUL ROADS	DAILY OR AS REQUIRED	1. REGRADE AND ADD GRAVEL TO MAINTAIN ORIGINAL GRADE AND CONDITION. 2. REMOVE ANY MATERIAL DROPPED FROM HAUL TRUCKS.
TWRMF & , CWBs	MONTHLY*	1. INSPECT EXTERIOR BERM VEGETATION. 2. REPAIR EROSION AND RESEED, FERTILIZE AND MULCH AREAS.

*MONTHLY OR AFTER A RAIN EVENT EXCEEDING 1/2 INCH IN A 24 HOUR PERIOD OR FOLLOWING HEAVY SNOW MELT RUNOFF.



N

LEGEND

- MINERAL PROPERTY BOUNDARY
- PROJECT BOUNDARY
- 220 EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- NWI NON-DELINEATED WETLAND
- DESIGNED PIT PERIMETER
- PROPOSED FENCE
- PROPOSED STRUCTURE
- PROPOSED ROADWAY (GRAVEL SURFACE)
- PROPOSED TWRMF LIMITS
- 230 DESIGN CONTOUR
- NON-CONTACT STORM WATER BASIN
- NON-CONTACT WATER DRAINAGE DITCH
- CONTACT WATER DRAINAGE DITCH
- PROPOSED SILT FENCE
- PROPOSED SEEDED AREAS
- PROPOSED GRASS BUFFER STRIP
- PROPOSED TRACKING PAD
- PROPOSED GRAVEL ROADWAY
- PROPOSED CULVERT
- NON-CONTACT STORM WATER DITCH
- PROPOSED CUT-OFF WALL
- WATER TREATMENT DISCHARGE PIPELINE
- PROPOSED OXIDE TAILINGS PIPELINE
- PROPOSED FLOTATION TAILINGS PIPELINE
- PROPOSED OXIDE TAILINGS THICKENER TANK
- PROPOSED FLOTATION TAILINGS THICKENER TANK

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. BACK FORTY PROJECT AREA WITHIN SECTION 1 AND 12, T35N, R29W, LAKE TOWNSHIP, MENOMINEE COUNTY, MICHIGAN.
4. DESIGN BASE GRADES SHOWN FOR TWRMF. REFER TO PHASE DRAWINGS FOR WASTE ROCK GRADING PLAN.
5. FINAL DESIGN EXCAVATION GRADES SHOWN FOR MINE PIT.
6. STOCKPILE GRADES AND SLOPES ARE APPROXIMATE.

FACILITY LAYOUTS SUBJECT TO CHANGE

80 0 80 160 240
SCALE 1:8,000 METERS

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	JOS1	DATE:	MAY '16
REVIEWED BY:	KKB	DATE:	MAY '16
APPROVED BY:	KKB	DATE:	MAY '16

BACK FORTY PROJECT

FIGURE 6-1
MINING PERMIT APPLICATION
PROJECT DESCRIPTION AT END OF CONSTRUCTION

Scale:	AS SHOWN	Date:	MAY 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\MDEQ response figures\Figure 6-1 Project description at end of construction.dgn
6/10/2016 bjw1

Attachment 16

Plan

Cyanide Management Plan

Project I.D.: 14A021

Aquila Resources Inc.
Stephenson, Michigan

June 2016

Cyanide Management Plan

Project ID: 14A021

Prepared for

Aquila Resources, Inc.

Stephenson, Michigan

Prepared by

Foth Infrastructure & Environment, LLC

June 2016

2121 Innovation Court, Ste. 300 • PO Box 5126 • De Pere, WI 54115-5126 • (920) 497-2500 • Fax: (920) 497-8516 • www.foth.com

Cyanide Management Plan

Contents

Contents (*continued*)

Page

List of Abbreviations, Acronyms, and Symbols

Aquila	Aquila Resources, Inc.
CMP	Cyanide Management Plan
Foth	Foth Infrastructure & Environment, LLC
ICMI	International Cyanide Management Institute
IFC	World Bank/International Finance Corporation
MSHA	Mine Safety and Health Administration
NPDES	National Pollutant Discharge Elimination System

1 Introduction

As a gold producer, Aquila Resources Inc. (Aquila) plans to become a signatory to the Cyanide Management Code as set forth by the International Cyanide Management Institute (ICMI). The Cyanide Management Code has been widely and successfully applied in international gold projects for management of cyanide, and is recognized by the World Bank/International Finance Corporation (IFC) as a best practice for management of cyanide in all mining operations where this product is used. As a signatory to the Code, the company will commit to follow the Cyanide Management Code's principles and standards of practice. To demonstrate compliance with the Cyanide Management Code, the company has developed a Cyanide Management Plan (CMP) that outlines how it will conform to stated principles and standards of practice. The CMP outlines procedures to address production, transportation, storage and use, and decommissioning of cyanide facilities as part of its operations that manage cyanide.

1.1 Purpose

This CMP describes the practices and procedures that Aquila Resources, Inc. (Aquila) will apply to the procurement, delivery, storage and handling, and use of sodium cyanide for its operations at the Back Forty Project near Stephenson, Michigan. It is designed to address requirements of the International Cyanide Management Code and has been prepared using the Implementation Guidance to address all elements of the Code.

2 Cyanide Procurement

2.1 Contractual Requirements and Responsibility Assignments

Aquila will describe how cyanide will be procured from manufacturers. Contracts with independent distributors will require the distributor to provide verification that the product has been produced at a facility that is compliant with the Cyanide Management Code.

3 Cyanide Transportation

3.1 Contractual Requirements and Responsibility Assignments

Aquila will establish clear lines of responsibility for safety, security, release prevention, training, emergency response in written agreements with producers, distributors, and transporters. Consideration will be given to the following aspects:

- Packaging and product labeling;
- Storage prior to shipment;
- Evaluation and selection of optimal delivery routes, including community involvement;
- Interim loading, storage, and unloading during shipment;
- Safety and maintenance of the means of transportation;
- Safety and operational/task training for all transportation personnel, throughout transport;
- Emergency response throughout transport; and
- Contractor training.

4 Cyanide Receipt, Handling, and Storage

4.1 Cyanide Unloading and Storage

Cyanide will be received at a designated unloading area within the facility and unloading will be performed in a covered area and on a concrete surface to prevent spillage from contacting the environment. Additional details on the design of this area will be provided as more details on the Reagents and Oxide Buildings are specified.

4.2 Cyanide Mixing and Solution Storage

Cyanide mixing tanks will be located on a concrete surface and secondary containment will be provided to hold a volume of leakage greater than that of the largest mixing tank. More details on the design and management during mixing will be provided as additional details of the cyanide management area are provided.

4.3 Prevention of Cyanide Releases and Workforce Exposures

Aquila will develop a set of written procedures designed to prevent or control exposures and releases during cyanide unloading, storage, and mixing operations. These procedures will be in the form of either an operating manual, standard operating procedures, checklists, signs, training materials, or other written formats and will address items listed below:

- Contingency procedures for responding to releases and worker exposure that may occur during unloading, mixing, and storage of cyanide;
- Procedures for unloading, storage, and mixing cyanide, including measures to minimize worker exposure and control releases to the environment;
- Cyanide-specific first aid kits will be provided;
- A description of spill neutralization and cleanup equipment that will be readily available in these areas;
- Inspection procedures for pipelines, pumps, valves, and tanks located in the areas; and
- Procedures for management of empty cyanide containers.

5 Operational Process Controls

5.1 Operating Plans and Procedures

Management and operating systems will be designed to protect human health and the environment, including contingency planning and inspection and preventive maintenance procedures. This will include a set of written management systems, including operating plans and procedures as the link between the final design of the cyanide management areas and its operation. The plans and/or procedures will describe the standard practices necessary for the safe and environmentally sound operation of the facility and the specific measure needed for compliance with the Cyanide Management Code.

5.2 Optimization of Cyanide Usage

Management and operation systems will be introduced to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings. Current plans are as described in the Mining Permit Application. Residual cyanide in the wash circuit underflow at the oxide plant and in the sludge from the clarifying filters will be destroyed in an oxidation circuit. More details on this process will be provided in this plan as the oxide flow description is further refined through detailed design of the beneficiation plant.

5.3 Water Balance Management

This section will provide details on a comprehensive water management program to protect against unintentional releases. Per instructions in the Cyanide Management Plan Implementation Guidance, the water balance management program will be probabilistic in nature, taking into account the uncertainty and variability inherent in the prediction of precipitation patterns. As stated in Section 5.2, design of the cyanide management system will limit concentrations of cyanide in mill tailings and should therefore limit exposure of cyanide to storm water.

5.4 Wildlife Protection

The CMP will describe measures that will be in place to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions. At this point, it is anticipated that given cyanide should not be present in the tailings from the oxide plant, exposure to wildlife and birds will be minimal as sources of cyanide should not be located outdoors.

5.5 Management of Direct/Indirect Process Solution Discharges

The CMP will implement measures as needed to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water. Additional details on this aspect will be provided through implementation of requirements under the National Pollutant Discharge Elimination System (NPDES) permit that will be issued for the mine.

5.6 Management of Cyanide Facility Groundwater Impacts

Consideration of potential groundwater impacts will be incorporated into the design of cyanide management systems. A monitoring program for cyanide throughout the facility is included in the Environmental Monitoring Plan.

5.7 Spill Prevention and Containment Measures for Process Solution Tanks and Pipelines

A description will be provided regarding spill prevention and/or containment measures for process tanks and pipelines. For the most part, all process tanks and pipelines will be contained within the oxide plant.

5.8 Construction Quality Assurance/Quality Control Program

Per requirements of Implementation Guidance for the Cyanide Management Code, quality assurance and quality control procedures will be developed to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications. This will include all unloading areas, storage tanks, mixing tanks, secondary containment, pipelines, and other structures.

5.9 Wildlife and Surface/Groundwater Quality Monitoring Programs

Overall requirements for the monitoring of surface and groundwater quality are described by the Environmental Monitoring Plan. These requirements will be referenced here in the final version of the CMP.

6 Decommissioning of Cyanide Facilities

6.1 Decommissioning Planning

Procedures will be planned and implemented for effective decommissioning of cyanide facilities to protect human health, wildlife, and the environment. Decommissioning of cyanide facilities will be coordinated with activities outlined in the Reclamation Plan.

6.2 Financial Assurance Mechanism

Financial assurance and cost estimates are provided in the Financial Assurance Plan. A statement of financial responsibility to meet the requirements listed under R 425.307 will be issued by Aquila when such requirements have been agreed upon with the Michigan Department of Environmental Quality. This section will further describe those portions of the facility associated with cyanide management and potential closure costs that pertain to these structures.

7 Worker Safety

Aquila Resources is committed to the protection of the health and safety of its employees, on-site contractors, and site visitors. Written procedures will be developed and implemented to provide guidance on the following:

- The assessment and management of cyanide exposure risks in the workplace;
- Management of workplace hazards associated with the use of cyanide; and
- Maintenance of equipment and the workplace in a safe condition.

7.1 Identification and Management of Cyanide Exposure Scenarios

The company will develop and maintain operating procedures for managing its facilities to limit worker exposure to hydrogen cyanide gas and cyanide salts to limitations specified by the Mine Safety and Health Administration (MSHA).

7.2 Operational Monitoring of Cyanide Facility Worker Health and Safety

The facility will conduct operational monitoring of equipment and operations that handle cyanide products to protect worker health and safety and will periodically evaluate the effectiveness of health and safety measures. It will include the following:

- Management of pH in cyanide mixing tanks to minimize the potential for hydrogen cyanide gas generation;
- Utilize ambient and personal monitoring devices to detect potential exposure to hydrogen cyanide; and
- Conduct investigations of potential exposure incidents.

7.3 Emergency Preparedness and Response Plans and Procedures

An emergency response procedure will be developed to respond to worker exposure incidents involving cyanide.

8 Emergency Response

8.1 Emergency Response Planning

An emergency response plan will be prepared to respond to potential cyanide releases that could impact human health or the environment. It will include the following:

- Identification of sources that could result in potential cyanide releases;
- Potential cyanide emergency scenarios;
- Responses to transportation-related emergencies; and
- Response actions.

8.2 Stakeholder Engagement in Emergency Response Planning Process

The facility will involve site personnel and stakeholders in the planning process. It will include the following aspects:

- Planning for workforce/stakeholder engagement;
- Consultation with potentially affected individuals and communities;
- Consultation with local response agencies and medical facilities; and
- Stakeholder engagement in emergency response plan updates.

8.3 Commitment of Resources and Personnel for Emergency Response

The company will designate appropriate personnel and commit equipment and resources for emergency response. The following actions and procedures will be implemented:

- Primary and alternate emergency response coordinators will be designated;
- The coordinator will have explicit authority to commit the necessary resources;
- Emergency response teams will be identified and appropriately trained and prepared;
- The Emergency Response Plan will specify call-out procedures and 24-hour contact information for the coordinators and response team members; and
- The duties of the coordinators and response team members will be specified.

8.4 Internal/External Emergency Notification and Reporting Procedures

The Emergency Response Plan will include procedures for internal and external emergency notification and reporting.

8.5 Remediation Measures / Monitoring Elements for Cyanide Hazards

The Emergency Response Plan will include remediation measures and additional monitoring that may be required in event there is an incident involving recovery or treatment of solutions, solids, decontamination of soils or other contaminated media, and management and/or disposal of spill

cleanup debris. The Emergency Response Plan will identify possible cyanide release scenarios that may reasonably occur at the site.

8.6 Evaluation and Update of Emergency Response Procedures and Capabilities

The Emergency Response Plan will periodically be evaluated for its effectiveness and will be revised as needed. The facility will conduct mock emergency drills to test the adequacy of response measures for cyanide exposures and/or releases.

9 Training of Workers and Emergency Response Personnel

9.1 Cyanide Hazard Recognition Training

All personnel who encounter cyanide will be trained on its hazards. This training will include recognition of cyanide materials at the operation, information regarding the health effects of cyanide, symptoms of cyanide exposure, and procedures to follow in the event of exposure.

9.2 Operational Training Requirements

Appropriate personnel will be trained to operate the facility and equipment that manage cyanide products according to systems and procedures that have been established to protect human health, the community, and the environment.

9.3 Cyanide Release Response Training

Appropriate site workers and response personnel will be trained to respond to worker exposures and environmental releases of cyanide. Specific procedures will be developed to meet this requirement.

10 Pubic Dialogue and Disclosure

10.1 Stakeholder Outreach and Opportunities for Communication

The company will develop a program to provide the opportunity for stakeholders to communicate on issues of concern. Methods to foster input may include open public meetings, creation of citizens' advisory panels, and site tours for interested parties.

10.2 Dissemination of Cyanide Information to External and Internal Stakeholders

The program will include general written or visual information on cyanide, its use in the mining process at the Back Forty Project, and the general practices established to protect the environment and the health and safety of the workforce and the public due to potential spills or releases. Information will be disseminated in the form of brochures, newsletters, or other educational materials at the operation or at locations in the communities, at public forums, libraries, local government offices, on websites, or through other means.

11 References

International Cyanide Management Institute, *International Cyanide Management Code*. Accessed on May 27, 2016 at the following link: http://www.cyanidecode.org/about-cyanide-code/cyanide-code

International Cyanide Management Institute, *International Cyanide Management Code Implementation Guidance*. Accessed on May 27, 2016 at the following link: http://www.cyanidecode.org/become-signatory/implementation-guidance.

INTERNATIONAL CYANIDE MANAGEMENT INSTITUTE

The International Cyanide Management Code

www.cyanidecode.org

December 2014

The International Cyanide Management Code (hereinafter "the Cyanide Code"") and other documents or information sources referenced at *www.cyanidecode.org* are believed to be reliable and were prepared in good faith from information reasonably available to the drafters. However, no guarantee is made as to the accuracy or completeness of any of these other documents or information sources. No guarantee is made in connection with the application of the Cyanide Code, the additional documents available or the referenced materials to prevent hazards, accidents, incidents, or injury to employees and/or members of the public at any specific site where gold is extracted from ore by the cyanidation process. Compliance with the Cyanide Code is not intended to and does not replace, contravene or otherwise alter the requirements of any specific national, state or local governmental statutes, laws, regulations, ordinances, or other requirements regarding the matters included herein. Compliance with the Cyanide Code is entirely voluntary and is neither intended nor does it create, establish, or recognize any legally enforceable obligations or rights on the part of its signatories, supporters or any other parties.

SCOPE

The Cyanide Code is a voluntary initiative for the gold mining industry and the producers and transporters of the cyanide used in gold mining. It is intended to complement an operation's existing regulatory requirements. Compliance with the rules, regulations and laws of the applicable political jurisdiction is necessary; the Cyanide Code is not intended to contravene such laws.

The Cyanide Code focuses exclusively on the safe management of cyanide that is produced, transported and used for the recovery of gold, and on mill tailings and leach solutions. The Cyanide Code originally was developed for gold mining operations, and addresses production, transport, storage, and use of cyanide and the decommissioning of cyanide facilities. It also includes requirements related to financial assurance, accident prevention, emergency response, training, public reporting, stakeholder involvement and verification procedures. Cyanide producers and transporters are subject to the applicable portions of the Cyanide Code identified in their respective Verification Protocols.

It does not address all safety or environmental activities that may be present at gold mining operations such as the design and construction of tailings impoundments or long-term closure and rehabilitation of mining operations.

The term "cyanide" used throughout the Cyanide Code generically refers to the cyanide ion, hydrogen cyanide, as well as salts and complexes of cyanide with a variety of metals in solids and solutions. It must be noted that the risks posed by the various forms of cyanide are dependent on the specific species and concentration. Information regarding the different chemical forms of cyanide is found at *http://www.cyanidecode.org/cyanide-facts/cyanide-chemistry* .

CYANIDE CODE IMPLEMENTATION

As it applies to gold mining operations, the Cyanide Code is comprised of two major elements. The Principles broadly state commitments that signatories make to manage cyanide in a responsible manner. Standards of Practice follow each Principle, identifying the performance goals and objectives that must be met to comply with the Principle. The Principles and Practices applicable to cyanide production and transportation operations are included in their respective Verification Protocols. Operations are certified in compliance with the Cyanide Code upon the International Cyanide Management Institute's announcement on the Cyanide Code website that an independent third-party audit has verified that they have met the Standards of Practice, Production Practices or Transport Practices.

For implementation guidance, visit *http://www.cyanidecode.org/become-signatory/implementation-guidance*

The programs and procedures identified by the Cyanide Code's Principles and Standards of Practice and in the Cyanide Production and Transportation Verification Protocols for the management of cyanide can be developed separately from other programs, or they can be integrated into a site's overall safety, health and environmental management programs. Since

mining operations typically do not have direct control over all phases of cyanide production, transport or handling, gold mines that are undergoing Verification Audits for certification under the Cyanide Code will need to require that other entities involved in these activities commit to and demonstrate that they adhere to the Cyanide Code's Principles and meet its Standards of Practice for these activities.

The Cyanide Code, the implementation guidance, mine operators' guide, and other documents or information sources referenced at *www.cyanidecode.org* are believed to be reliable and were prepared in good faith from information reasonably available to the drafters. However, no guarantee is made as to the accuracy or completeness of any of these other documents or information sources. The implementation guidance, mine operators guide, and the additional documents and references are not intended to be part of the Cyanide Code. No guarantee is made in connection with the application of the Cyanide Code, the additional documents available or the referenced materials to prevent hazards, accidents, incidents, or injury to employees and/or members of the public at any specific site where gold is extracted from ore by the cyanidation process. Compliance with the Cyanide Code is not intended to and does not replace, contravene or otherwise alter the requirements of any specific national, state or local governmental statutes, laws, regulations, ordinances, or other requirements regarding the matters included herein. Compliance with the Cyanide Code is entirely voluntary and is neither intended nor does it create, establish, or recognize any legally enforceable obligations or rights on the part of its signatories, supporters or any other parties.

PRINCIPLES AND STANDARDS OF PRACTICE

1. PRODUCTION Encourage responsible cyanide manufacturing by purchasing from manufacturers who operate in a safe and environmentally protective manner.

Standard of Practice

1.1 Purchase cyanide from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

2. TRANSPORTATION Protect communities and the environment during cyanide transport.

Standards of Practice

2.1 Establish clear lines of responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors and transporters.

2.2 Require that cyanide transporters implement appropriate emergency response plans and capabilities, and employ adequate measures for cyanide management.

3. HANDLING AND STORAGE Protect workers and the environment during cyanide handling and storage.

Standards of Practice

3.1 Design and construct unloading, storage and mixing facilities consistent with sound, accepted engineering practices and quality control and quality assurance procedures, spill prevention and spill containment measures.

3.2 Operate unloading, storage and mixing facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

4. OPERATIONS Manage cyanide process solutions and waste streams to protect human health and the environment.

Standards of Practice

4.1 Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures.

4.2 Introduce management and operating systems to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings.

4.3 Implement a comprehensive water management program to protect against unintentional releases.

4.4 Implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.

4.5 Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water.

4.6 Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water.

4.7 Provide spill prevention or containment measures for process tanks and pipelines.

4.8 Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

4.9 Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and ground water quality.

5. DECOMMISSIONING **Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.**

Standards of Practice

5.1 Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

5.2 Establish an assurance mechanism capable of fully funding cyanide-related decommissioning activities.

6. WORKER SAFETY **Protect workers' health and safety from exposure to cyanide.**

Standards of Practice

6.1 Identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce and control them.

6.2 Operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

6.3 Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

7. EMERGENCY RESPONSE **Protect communities and the environment through the development of emergency response strategies and capabilities.**

Standards of Practice

7.1 Prepare detailed emergency response plans for potential cyanide releases.

7.2 Involve site personnel and stakeholders in the planning process.

7.3 Designate appropriate personnel and commit necessary equipment and resources for emergency response.

7.4 Develop procedures for internal and external emergency notification and reporting.

7.5 Incorporate into response plans monitoring elements and remediation measures that account for the additional hazards of using cyanide treatment chemicals.

7.6 Periodically evaluate response procedures and capabilities and revise them as needed.

8. TRAINING Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Standards of Practice

8.1 Train workers to understand the hazards associated with cyanide use.

8.2 Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

8.3 Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

9. DIALOGUE Engage in public consultation and disclosure.

Standards of Practice

9.1 Provide stakeholders the opportunity to communicate issues of concern.

9.2 Initiate dialogue describing cyanide management procedures and responsively address identified concerns.

9.3 Make appropriate operational and environmental information regarding cyanide available to stakeholders.

CYANIDE CODE MANAGEMENT

Administration

The International Cyanide Management Institute ("The Institute" or "ICMI") is a non-profit corporation established to administer the Cyanide Code through a multi- stakeholder Board of Directors consisting of representatives of the gold mining industry and participants from other stakeholder groups. For additional information on the Institute, see: *http://www.cyanidecode.org/about-icmi*.

The Institute's primary responsibilities are to:

- Promote adoption of and compliance with the Cyanide Code, and to monitor its effectiveness and implementation within the world gold mining industry.
- Develop funding sources and support for Institute activities.
- Work with governments, NGOs, financial interests and others to foster widespread adoption and support of the Cyanide Code.
- Identify technical or administrative problems or deficiencies that may exist with Cyanide Code implementation, and
- Determine when and how the Cyanide Code should be revised and updated.

Cyanide Code Signatories

Gold mining companies and the producers and transporters of cyanide used in gold mining can become signatories to the Cyanide Code. By becoming a signatory, a company commits to follow the Cyanide Code's Principles and implement its Standards of Practice, or in the case of producers and transporters, the Principles and Practices identified in their respective Verification Protocols. Cyanide Code signatories' operations will be audited by an independent third-party auditor to verify their compliance with the Cyanide Code.

When becoming a signatory, a company must specify which of its operations it intends on having certified. Only those cyanide production and transportation facilities that are related to the use of cyanide in gold mining are subject to certification.

Signatories pay annual fees to support the Institute's activities. Failure to pay the required fee results in the company's termination from participation in the Cyanide Code program. See: http://www.cyanidecode.org/signatory-companies/directory-of-signatory-companies.

Cyanide Code Verification and Certification

Active operations must be audited to verify their compliance with the Cyanide Code within three years of being designated for certification. This requirement is met if the site inspection portion of the audit has been conducted by the applicable deadline. A certified operation must have the site inspection portion of its next audit conducted within three years of the effective date of its previous audit, which is the date the Institute posts its Summary Audit Report and announces its certification on the Cyanide Code website.

During an *initial* verification audit, an operation's compliance at the time of the audit will be evaluated. Subsequent *recertification* audits also will evaluate compliance during the period between the preceding and current audits.

Audits are to be conducted by independent, third-party professionals. Auditors are selected and hired by the signatory or operation but must meet the Institute's criteria for their experience and expertise. Auditors evaluate an operation against the applicable Cyanide Code Verification Protocol to determine if its management of cyanide achieves the Code's Principles and Standards of Practice, or the Production or Transport Practices for these types of operations. Operations must make all relevant data available to the auditors, including the complete findings of their most recent independent Cyanide Code Verification Audit, in order to be considered for certification.

Submission of audit results; finding of full compliance: Before finalizing an audit report, the auditor must review the audit findings with the operation to ensure that the information presented is accurate. Within 90 days of completing the inspection of the operation, the auditor must submit: (1) a Detailed Audit Findings Report responding to the questions in the Verification Protocol; (2) a Summary Audit Report that includes the auditor's conclusion regarding the operation's compliance with the Cyanide Code; and (3) the auditor's credentials to the signatory, the operation and to the Institute.

ICMI will review the audit report to ensure that appropriate responses have been provided for all Verification Protocol questions and that adequate evidence has been included in support of the auditor's findings, and will advise the auditor and the operation when the report has been accepted as complete.

The operation will then be certified by the auditor as complying with the Cyanide Code if the auditor concludes that it is in full compliance with the Code's Principles and Standards of Practice, or its Principles and Practices for cyanide production or transportation, as applicable. The certification becomes effective when the Institute announces the certification and posts the Summary Audit Report on the Cyanide Code website.

The Detailed Audit Findings Report is the confidential property of the operation and shall not be released by the Institute in any fashion without the written consent of the signatory and/or audited operation. The Summary Audit Report and the credentials of the auditor(s) will be made available to the public on the Cyanide Code website. The operation may submit its comments regarding the Summary Audit Report to the Institute, which will be posted along with the Summary Audit Report on the Institute's website.

Finding of substantial compliance: Operations that are found in substantial compliance with the Cyanide Code are conditionally certified, subject to the successful implementation of a Corrective Action Plan. Substantial compliance means that the operation has made a good-faith effort to comply with the Cyanide Code and that the deficiencies identified by the auditor can be readily corrected and do not present an immediate or substantial risk to employee or community health, safety, or the environment.

Operations that are found in substantial compliance with a Standard of Practice, Production Practice or Transport Practice must develop and implement a Corrective Action Plan to correct the deficiencies identified by the verification audit. The operation shall request that the auditor review the Corrective Action Plan or assist in its development so that there is agreement between the operation and the auditor that its implementation will bring the operation into full compliance. The Corrective Action Plan addressing a finding of substantial compliance must include a time period, mutually agreed to by the operation and the auditor, to bring the operation into full compliance with the Cyanide Code. In no case shall this time period be longer than one year from the date on which ICMI posts the operation's Summary Audit Report on the Cyanide Code website. The auditor must submit the Corrective Action Plan to the Institute for posting on the Institute's website along with the Summary Audit Report.

Finding of non-compliance: Operations that were audited and found in non-compliance with one or more Standards of Practice, Production Practices or Transport Practices, and those that have not fully implemented a Corrective Action Plan by the applicable deadline, are in non-compliance with the Cyanide Code. To be certified, these operations must: (1) maintain compliance with those Standards or Practices that were found in full compliance during their audit; and (2) fully implement their Corrective Action Plans. Operations that do not fully implement their Corrective Action Plans within three years of the date their Summary Audit

Report was posted on the Institute's website also must submit to the Institute the report of a new audit with a finding of full compliance in order to be certified.

Corrective Action Plan and Completion Report: The operation must provide evidence to the auditor demonstrating that it has implemented the Corrective Action Plan as specified and in the agreed-upon time frame. In some cases, it may be necessary for the auditor to re-evaluate the operation to confirm that the Corrective Action Plan has been implemented. Upon receipt of the documentation that the Corrective Action Plan has been fully implemented, the auditor must provide a Completion Report to the Institute verifying that the operation is in full compliance with the Cyanide Code.

All operations certified in compliance with the Cyanide Code will be identified on the Code website, *http://www.cyanidecode.org/signatory-companies/directory-of-signatory-companies*. Each certified operation's Summary Audit Report will be posted. Operations found in substantial or non-compliance will have their Summary Audit Reports, Corrective Action Plans and Corrective Action Plan Completion Reports posted.

Pre-operational certification: A gold mining operation, cyanide production facility or cyanide transport operation that is not yet active but that is sufficiently advanced in its planning and design phases can request pre-operational conditional certification based on an auditor's review of its site plans and proposed operating procedures. An operation audited pre-operationally and found in full compliance will be certified conditionally, and remains so until the findings of its operational audit become effective. An on-site audit is required within one year of a gold mining operation's first receipt of cyanide at the site to confirm that the operation has been constructed and is being operated in compliance with the Cyanide Code. On-site audits of cyanide production facilities and cyanide transport operations are required within six months of their start of cyanide production or management activities. These operations must advise ICMI within 90 days of the date of the first receipt of cyanide at a gold mining operation or of the start of cyanide production or management activities at a cyanide production or transport operation. A new three-year certification period begins when the findings of the operational audit become effective.

Mining operations that have been designated for certification before they become active but which do not request pre-operational certification must be audited for compliance with the Cyanide Code within one year of their first receipt of cyanide, and also must advise ICMI within 90 days of the date of their first receipt of cyanide. Cyanide production facilities and cyanide transport operations that have been designated for certification before they become active but which do not request pre-operational certification must be audited for compliance with the Cyanide Code and be certified in full or substantial compliance before providing cyanide to a certified gold mine.

A gold mining operation or an individual cyanide facility at an operation is no longer subject to certification after decommissioning of the cyanide facilities. A producer or transporter is no longer subject to certification after it no longer produces or transports cyanide for use in the gold mining industry.

Certification Maintenance

In order to maintain certification, an operation must meet all of the following conditions:

- The auditor has concluded that it is either in full compliance or substantial compliance with the Cyanide Code.
- An operation in substantial compliance has submitted a Corrective Action Plan to correct its deficiencies and has demonstrated that it has fully implemented the Corrective Action Plan in the agreed-upon time.
- There is no verified evidence that the operation is not in compliance with the Cyanide Code.
- An operation has had a verification audit within three years.
- An operation has had a verification audit within two years of a change in ownership, defined as a change of the controlling interest of the operating company.

Re-admission, Re-designation and Re-activation

Signatory companies that have voluntarily withdrawn or have been terminated from participation in the Cyanide Code can seek re-admission to the program. Operations that had been certified or designated for certification but which were subsequently voluntarily withdrawn from the program by the signatory company can return to the program and be re-designated for certification.

Auditor Criteria and Review Process

The Institute has developed specific criteria for Cyanide Code Verification auditors and will implement procedures for review of auditor credentials. Auditor criteria includes requisite levels of experience with gold mining (or chemical production facilities or hazardous materials transport, as appropriate) and in conducting environmental, health or safety audits, certification as a professional health, safety or environmental auditorby a self-regulating organization and lack of conflicts of interest with operation(s) to be audited.

Dispute Resolution

The Institute has developed and implemented fair and equitable procedures for resolution of disputes regarding auditor credentials and certification and/or de-certification of operations. The procedures provide due process to all parties that may be affected by these decisions.

Information Availability

The Cyanide Code and related information and program management documentation are available via the Internet at www.cyanidecode.org. The website is intended to promote an understanding of the issues involved in cyanide management and to provide a forum for enhanced communication within and between the various stakeholder groups with interest in these issues. The website is the repository for Cyanide Code certification and verification information.

Attachment 17

435,000 E

436,000 E

437,000 E

5,034,000 N

5,033,000 N

MEMOMINEE RIVER

OXIDE TAILINGS AND WASTE ROCK MANAGEMENT FACILITY

FLOTATION TAILINGS AND WASTE ROCK MANAGEMENT FACILITY

PROPOSED CUT-OFF WALL

50m SETBACK FROM RIVER

TOPSOIL STOCKPILE

SOIL PROCCESSING AREA

ORE BLENDING AREA

CONTACT WATER BASIN

MAIN ENTRANCE/ GATE HOUSE

OVERBURDEN/GENERAL SOILS STOCKPILE

TOPSOIL STOCKPILE

CONTACT WATER BASIN

TAILINGS DUMP PONDS (~12m x 12m)

TOPSOIL STOCKPILE

A

A'

B

B'

C

C'

N

LEGEND

- PROJECT BOUNDARY
- MINERAL PROPERTY BOUNDARY
- PROPOSED TAILINGS AND WASTE ROCK STORAGE AREA LIMITS
- 220 EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- DESIGNED PIT PERIMETER
- PROPOSED FENCE
- PROPOSED STRUCTURE
- PROPOSED ROADWAY (GRAVEL SURFACE)
- PROPOSED ROADWAY (BITUMINOUS)
- PROPOSED WATER TREATMENT DISCHARGE PIPELINE
- 230 DESIGN CONTOUR
- PROPOSED NON CONTACT STORM WATER BASIN
- PROPOSED DITCH
- PROPOSED CUT-OFF WALL
- PROPOSED TAILINGS DUMP POND

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. CURRENT PIT DESIGN SUPPLIED BY AQUILA RESOURCES INC. VIA EMAIL, MAY 2015.
4. WETLANDS SUPPLIED BY ERM IN OCTOBER, 2009.
5. NATIONAL WETLAND INVENTORY (NWI) DOWNLOADED FROM MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION.
6. PLANT SITE FEATURES SUPPLIED BY LYCOPODIUM, JULY 2015.
7. STOCKPILE, CONTACT WATER AND PROCESSING AREA GRADES AND SLOPES ARE APPROXIMATE AND WILL BE UPDATED WITH THE PROJECT FINAL DESIGN.

100 0 100 200 300

SCALE 1:10,000 METERS

FACILITY LAYOUTS SUBJECT TO CHANGE

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	JUN. '16
REVIEWED BY:	JOS1	DATE:	JUN. '16
APPROVED BY:	JOS1	DATE:	JUN. '16

BACK FORTY PROJECT

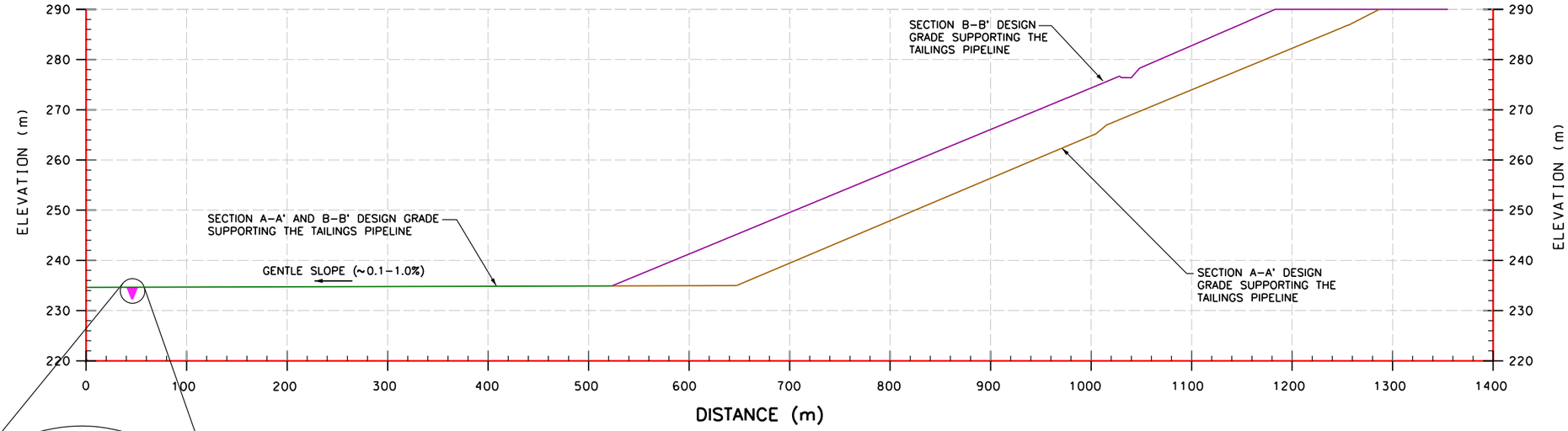
FIGURE 17-1

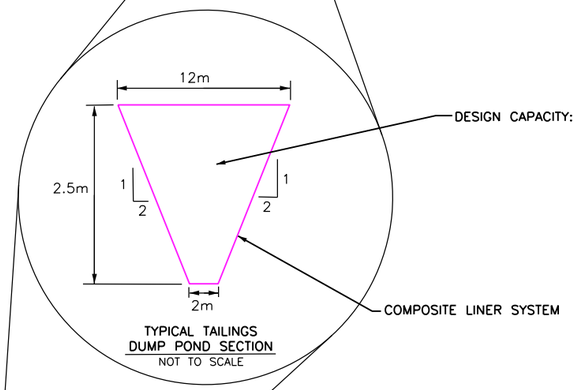
MPA COMMENT RESPONSE
TAILINGS DISCHARGE PIPING ALIGNMENT

Scale:	AS SHOWN	Date:	JUNE 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\TCP\Figure R17-1 tailings discharge pipeline alignment.dgn
6/10/2016 bjw1

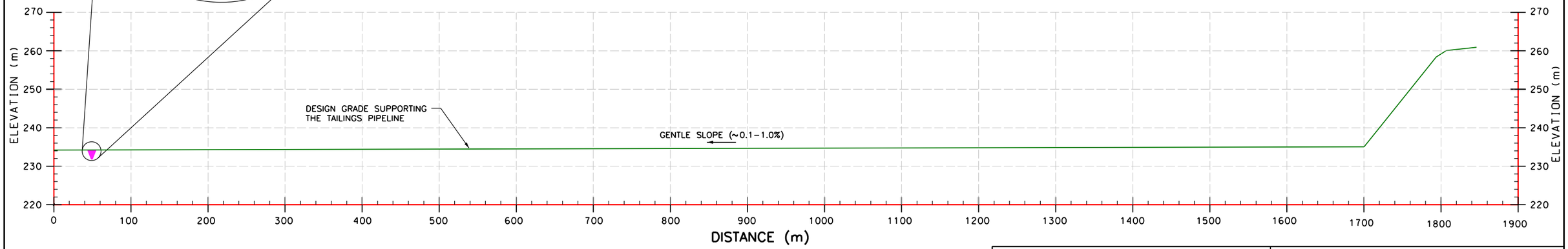
SECTION A–A' AND B–B'

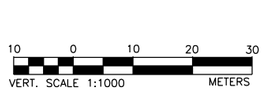




TYPICAL TAILINGS DUMP POND SECTION
NOT TO SCALE

SECTION C–C'





Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
PREPARED BY:	MJV2		DATE:	JUN. '16
REVIEWED BY:	JOS1		DATE:	JUN. '16
APPROVED BY:	JOS1		DATE:	JUN. '16

BACK FORTY PROJECT

FIGURE 17–2
MPA COMMENT RESPONSES
THICKENED TAILINGS DISCHARGE
PIPELINE PROFILES

Scale:	AS SHOWN	Date:	JUNE 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\TCP\Figure R17-2 tailings discharge pipeline profiles.dgn
6/10/2016 bjw1

Attachment 19

435,000 E

435,500 E

5,033,500 N

5,033,000 N

MENOMINEE

ROAD

POWER

TOPSOIL STOCKPILE

SOIL PROCESSING AREA AND EQUIPMENT/VEHICLE STAGING

WHEEL WASH

FUEL STATION

SNOW STORAGE AREA

ORE BLENDING AND TRUCK TURN AROUND

ROM PAD

TRUCK SHOP

TRANSFORMER

CRUSHING BLDG

MINING EQUIPMENT STORAGE AREA

TRANSFER TOWER

PARTIALLY COVERED FLOTATION ORE STOCKPILE

TOPSOIL STOCKPILE

CONTACT WATER BASIN

PARTIALLY COVERED OXIDE ORE STOCKPILE

MAIN POWER SUBSTATION

TRANSFORMERS

OVERBURDEN/GENERAL SOILS STOCKPILE

CONTACT WATER BASIN

OXIDE PLANT

REAGENT STORAGE SILOS

REAGENTS BUILDING

OXIDE THICKENER PLANT

FLOTATION THICKENER PLANT

WASTEWATER TREATMENT PLANT

TRUCK SCALE

PROPANE TANK

SEWAGE TREATMENT PLANT

ADMINISTRATION BUILDING

WAREHOUSE

N

LEGEND

- PROJECT BOUNDARY
- MINERAL PROPERTY BOUNDARY
- PROPOSED TAILINGS AND WASTE ROCK STORAGE AREA LIMITS
- 220 EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- DESIGNED PIT PERIMETER
- PROPOSED FENCE
- PROPOSED STRUCTURE
- PROPOSED ROADWAY (GRAVEL SURFACE)
- PROPOSED ROADWAY (BITUMINOUS)
- PROPOSED WATER TREATMENT DISCHARGE PIPELINE
- 230 DESIGN CONTOUR
- 125 FINAL PIT CONTOUR
- NON-CONTACT STORM WATER BASIN
- PROPOSED DITCH
- PROPOSED CUT-OFF WALL
- 100 YEAR FLOOD ELEVATION LIMITS

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. CURRENT PIT DESIGN SUPPLIED BY AQUILA RESOURCES INC. VIA EMAIL, MAY 2015.
4. WETLANDS SUPPLIED BY ERM IN OCTOBER, 2009.
5. NATIONAL WETLAND INVENTORY (NWI) DOWNLOADED FROM MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION.
6. PLANT SITE FEATURES SUPPLIED BY LYCOPODIUM, JULY 2015.
7. DESIGN GRADES AND SHAPES ARE APPROXIMATE AND WILL BE UPDATED WITH THE PROJECT FINAL DESIGN.

50 0 50 100 150

SCALE 1:5,000 METERS

FACILITY LAYOUTS SUBJECT TO CHANGE

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	JOS1	DATE:	MAY '16
REVIEWED BY:	KKB	DATE:	MAY '16
APPROVED BY:	KKB	DATE:	MAY '16

BACK FORTY PROJECT

FIGURE 19-1

MINING PERMIT APPLICATION
FINAL PIT PLAN

Scale:	AS SHOWN	Date:	MAY 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\MDEQ response figures\Figure 19-1 Final Pit Plan.dgn
6/10/2016 bjw1

Attachment 22

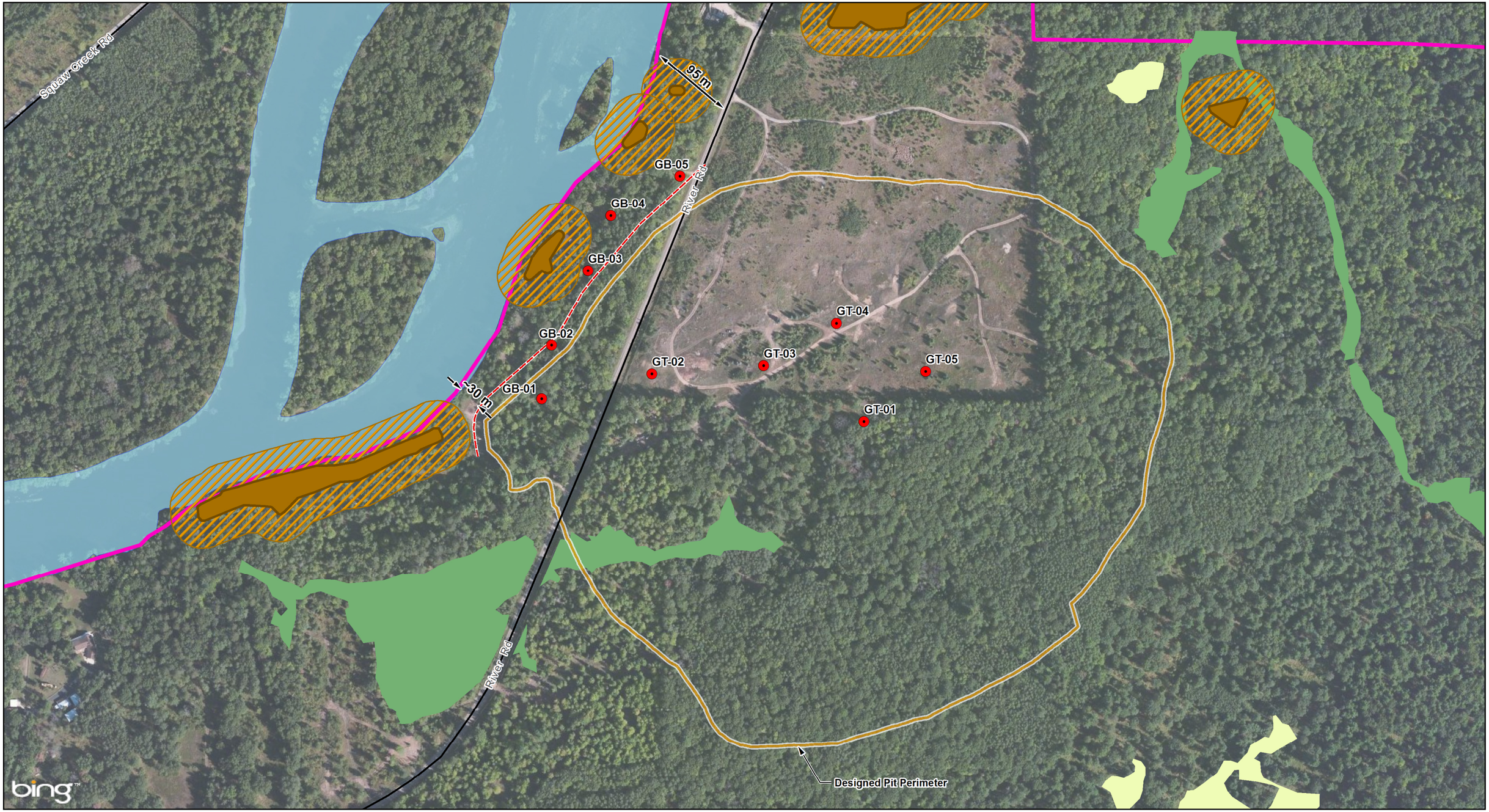
Table 22-1
Summary of Mine Pit Monitoring Activities

Mine Pit Monitoring Activity	Activity Description	Frequency
Visual inspection.	Routine mapping of geotechnical observations such as faults to verify existing interpretations of structural conditions in the rock mass. Identify location and extent of major continuous structures so their influence on slope stability can be assessed and design modified locally, if required.	Monthly
Surface and subsurface displacement monitoring.	Regular inspection of mine pit bench, face, and crest areas for early evidence of instability. Inspections should be conducted by the same individual to ensure continuity of the observations. Observations should be recorded in a diary so that stability performance can be maintained for each stage of pit development. Zones of potential failure should be surveyed regularly to provide advanced warning of unexpected movements.	Monthly
Slope pore pressure monitoring - to identify water pressures within the northwest and southwest portions of the pit that may impact slope stability.	Installation of small diameter exploratory horizontal drains (as needed) to examine flows in select critical areas as directed by a qualified hydrogeologist. Large flows could suggest the need for installing a dedicated slope pore water managment system to alleviate back slope pore pressure.	As directed by hydrogeologist
Blasting-related monitoring.	Post-blast monitoring to confirm stable slope conditions. ♦ slope survey to measure post-blast slope angle ♦ monitoring of surface features showing extensive or large cracks ♦ excessive water seepage from fractures ♦ unplanned displacement of rock mass	Post-blast

Prepared by: JOS1
Checked by: MJV2

Source: Adapted from Golder, 2006.

Attachment 28



NOTES

1. Imagery from esri and its data suppliers.
2. Hydrographic features generated from Michigan Geographic Framework and the Wisconsin DNR 24K Hydro datasets.
3. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
4. Wetlands supplied by ERM in June 2011.
5. Current pit design supplied by Aquila via email in May 2015.
6. Cultural resources findings supplied by CCRG in October 2011.

LEGEND

- Drillholes — GT - Open Pit Series (Golder 2011); GB - Cut-Off Wall Series (Golder 2011)
- Proposed Cut-off Wall (Foth)
- Roads
- Cultural Resource Locations
- Area of Investigation 30m Buffer
- Designed Pit Perimeter
- Project Boundary
- Non-Regulated Wetlands
- Regulated Wetlands

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	RXW	DATE:	JUN. '16
REVIEWED BY:	JOS1	DATE:	JUN. '16
APPROVED BY:	KKB	DATE:	JUN. '16

BACK FORTY PROJECT

FIGURE 28-1

SITE LOCATION PLAN SHOWING
OPEN PIT AND CUT-OFF WALL ALIGNMENT
STEPHENSON, MICHIGAN

Scale: 0 40 80 1:4,000 Meters

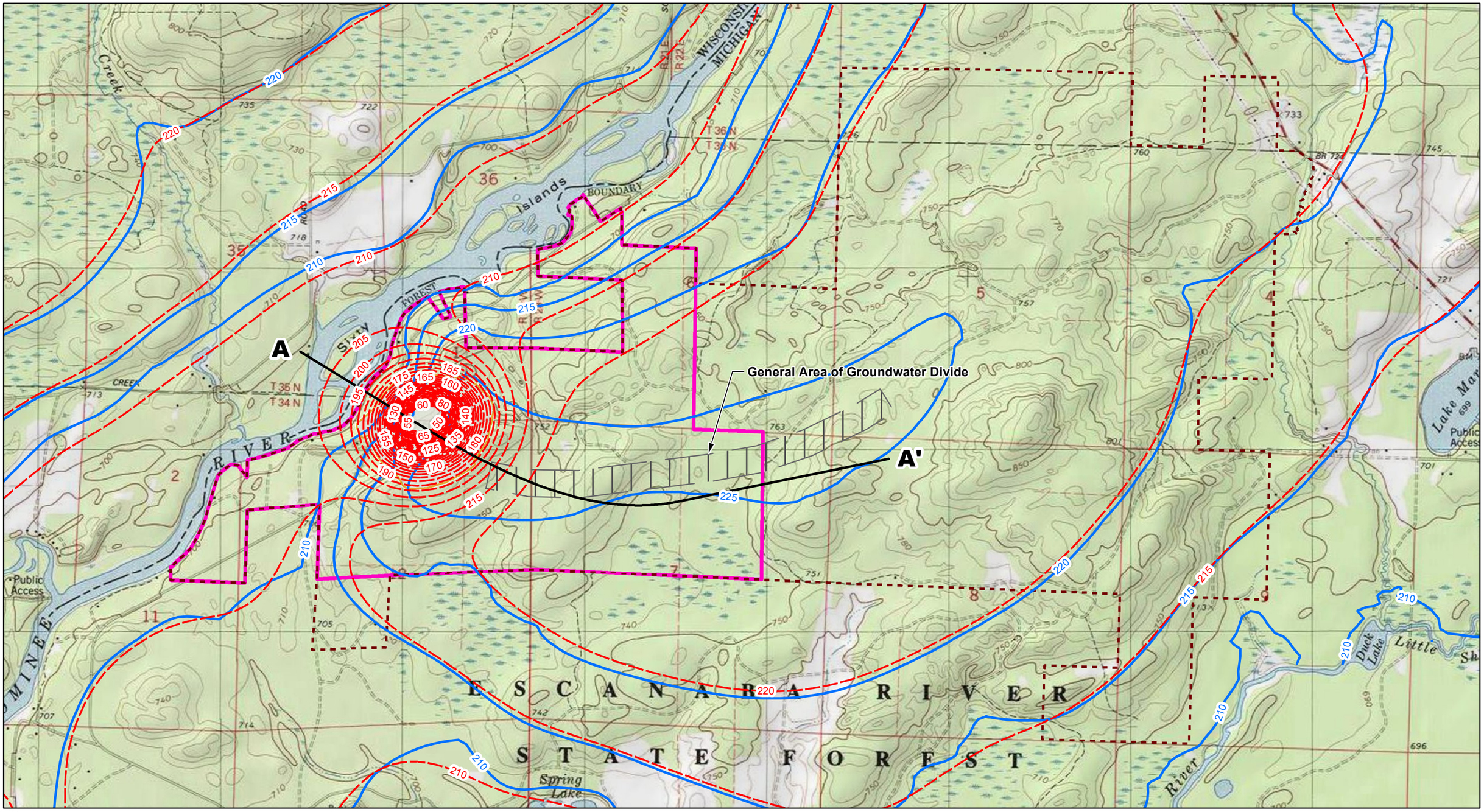
Date: JUNE 2016

Drafted by: DAT

Project No: 14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\MPA\Response to Comments\Figure 28-1 Site Location Plan - Pit and River Road.mxd Date: 6/6/2016

Attachment 39



NOTES

1. Topographic basemap from Esri and its data suppliers.
2. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
3. Current pit design supplied by Aquila via email in May 2015.
4. Groundwater elevations in Mine Year 6 are for deep bedrock. Groundwater elevations in upper reaches of groundwater system are higher. Pit dewatering induces vertical variations in head. It is not possible to show three-dimensionally-varying head distributions in 2D format.

LEGEND

- Groundwater Elevations in Mine Year 6, Deep Bedrock
- Modeled Groundwater Elevations, Existing Conditions
- Cross Section Location
- Designed Pit Perimeter
- Mineral Property Boundary
- Project Boundary

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	DRD	DATE:	JUN. '16
REVIEWED BY:	KKB	DATE:	JUN. '16
APPROVED BY:	KKB	DATE:	JUN. '16

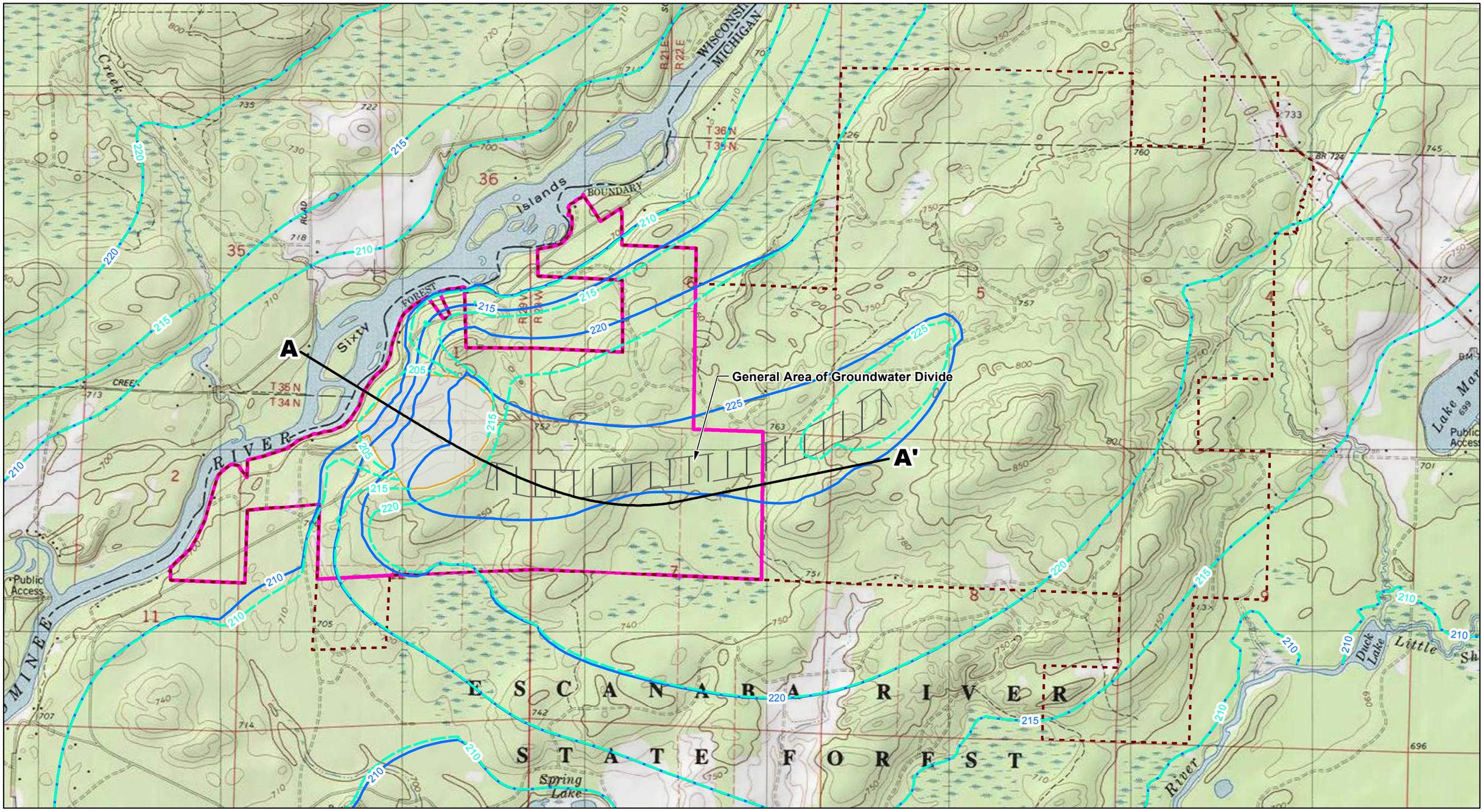
BACK FORTY PROJECT

FIGURE 39-1a

GROUNDWATER ELEVATION CONTOURS FOR EXISTING CONDITIONS AND PROPOSED CONDITIONS (MINE YEAR 6) WITH CUT-OFF WALL
STEPHENSON, MICHIGAN

Scale:	0 200 400 1:20,000 Meters	Date:	JUNE 2016
Drafted by:	DAT	Project No:	14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\MPA\Response to Comments\Figure 39-1a Groundwater elevation contours for existing conditions and proposed conditions (Mine Year 6) with Cutoff Wall.mxd Date: 6/10/2016



NOTES

1. Topographic basemap from Esri and its data suppliers.
2. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
3. Current pit design supplied by Aquila via email in May 2015.
4. Groundwater elevations in Mine Year 6 are for deep bedrock. Groundwater elevations in upper reaches of groundwater system are higher. Pit dewatering induces vertical variations in head. It is not possible to show three-dimensionally-varying head distributions in 2D format.

LEGEND

- Groundwater Elevations in Mine Year 6, Uppermost Saturated Geologic Materials
- Modeled Groundwater Elevations, Existing Conditions
- Cross Section Location
- Designed Pit Perimeter
- Mineral Property Boundary
- Project Boundary

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
PREPARED BY:	DRD		DATE:	JUN. '16
REVIEWED BY:	KKB		DATE:	JUN. '16
APPROVED BY:	KKB		DATE:	JUN. '16

BACK FORTY PROJECT

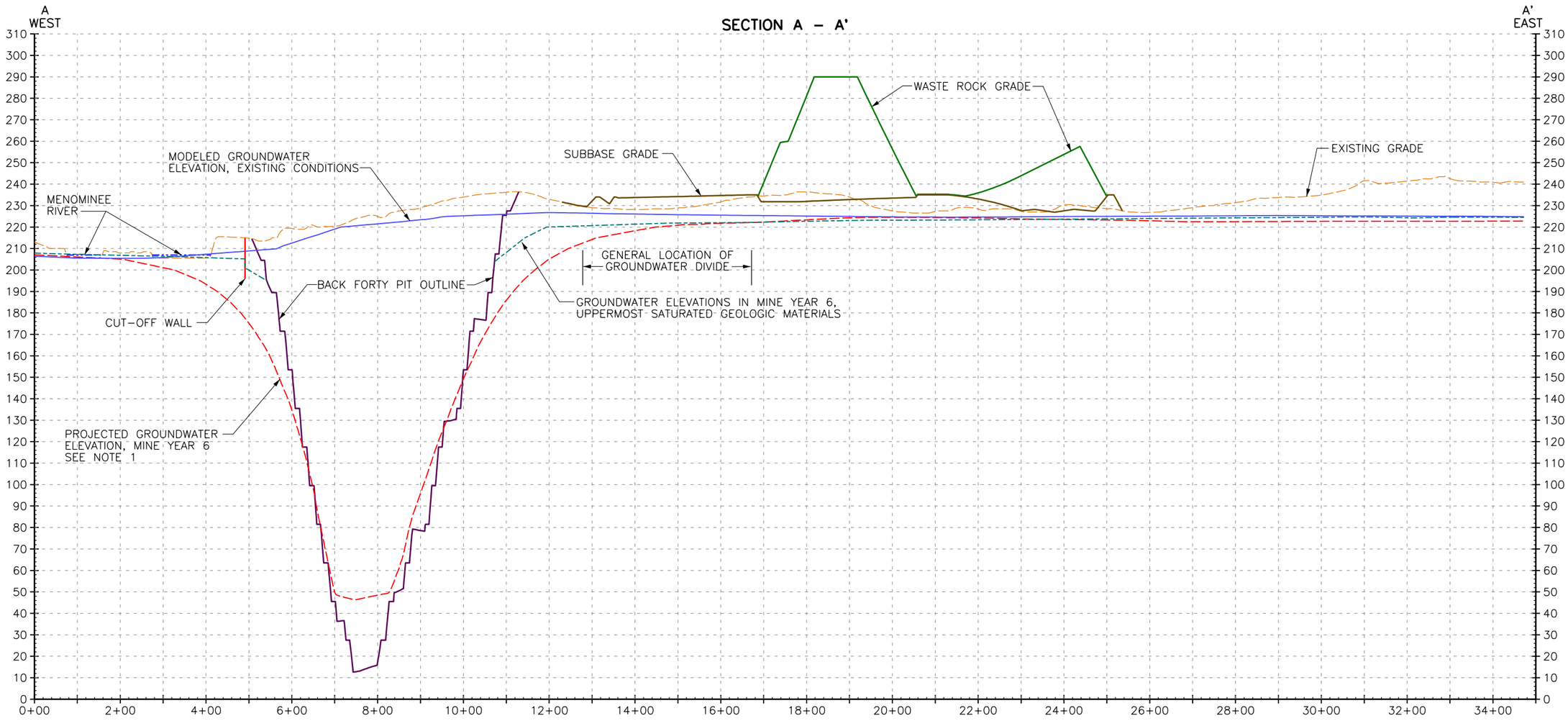
FIGURE 39-1b

GROUNDWATER ELEVATION CONTOURS FOR EXISTING CONDITIONS AND PROPOSED CONDITIONS (MINE YEAR 6) WITH CUT-OFF WALL
STEPHENSON, MICHIGAN

Scale:	0 200 400 1:20,000 Meters	Date:	JUNE 2016
Drafted by:	DAT	Project No:	14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\MPA\Response to Comments\Figure 39-1b Groundwater elevation contours for existing conditions and proposed conditions (Mine Year 6) with Cutoff Wall.mxd Date: 6/10/2016

SECTION A – A'



NOTES:

1. GROUNDWATER ELEVATIONS IN MINE YEAR 6 ARE FOR DEEP BEDROCK. GROUNDWATER ELEVATIONS IN UPPER REACHES OF GROUNDWATER SYSTEM ARE HIGHER. PIT DEWATERING INDUCES VERTICAL VARIATIONS IN HEAD. IT IS NOT POSSIBLE TO SHOW THREE–DIMENSIONALLY–VARYING HEAD DISTRIBUTIONS IN 2D FORMAT.

2. GROUNDWATER ELEVATIONS IN MINE YEAR 6 REFLECT HYDRAULIC HEAD IN DEEP BEDROCK. HEADS VARY IN THE VERTICAL DIMENSION AND CANNOT BE DISPLAYED FOR ALL DEPTHS IN A SINGLE 2D–VIEW.

20 0 20 40 60
VERT. SCALE 1:100 METERS

100 0 100 200 300
HOR. SCALE 1:10,000 METERS

FACILITY LAYOUTS SUBJECT TO CHANGE

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	DRD	DATE:	JUN.'16
REVIEWED BY:	KKB	DATE:	JUN.'16
APPROVED BY:	KKB	DATE:	JUN.'16

BACK FORTY PROJECT

FIGURE 39–2
CROSS–SECTION OF AMBIENT WATER LEVELS AND PROJECTED WATER LEVELS IN MINE YEAR 6 WITH CUTOFF WALL IN PLACE

Scale:	AS SHOWN	Date:	JUNE 2016
Drafted By:	JOW	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\EMP\Response to MDEQ\EMP Fig 39-2 cross section location map.dgn
6/10/2016 bjw1

Attachment 44

Table 44-1

Groundwater Monitoring and Sampling Locations

Well ID	Well Type	Facility Monitored	Sample Type
CW-1	Compliance Well	TWRMF	WQ
CW-2	Compliance Well	TWRMF	WQ
CW-3	Compliance Well	TWRMF	WQ
CW-4	Compliance Well	TWRMF	WQ
CW-5	Compliance Well	TWRMF	WQ
CW-6	Compliance Well	TWRMF	WQ
CW-7	Compliance Well	TWRMF	WQ
CW-8	Compliance Well	CWB	WQ
CW-9	Compliance Well	CWB	WQ
CW-10	Compliance Well	CWB	WQ
CW-11	Compliance Well	Pit	WQ
CW-12	Compliance Well	Processing Area	WQ
MW2	Compliance Well	TWRMF and Pit	WQ
MW8	Compliance Well	Pit and Overburden Stockpiles	WQ
MW18P	Compliance Well	Pit	WQ
GMW-3	Compliance Well	Pit	WQ
GMW-5	Compliance Well	Pit	WQ
LW-1	Leachate Well	TWRMF	WQ
LW-2	Leachate Well	TWRMF	WQ
LW-3	Leachate Well	TWRMF	WQ
LW-4	Leachate Well	CWB	WQ
FMW-8	Monitoring Well	General	GW Elevation Only
MW10	Monitoring Well	General	GW Elevation Only
FMW-7	Monitoring Well	General	GW Elevation Only
MW5	Monitoring Well	General	GW Elevation Only
FMW-1	Monitoring Well	General	GW Elevation Only
MW8	Monitoring Well	General	GW Elevation Only
MW7	Monitoring Well	General	GW Elevation Only
FMW-6	Monitoring Well	General	GW Elevation Only
MW3	Monitoring Well	General	GW Elevation Only
MW9	Monitoring Well	General	GW Elevation Only

Abbreviations:

CWB = Contact Water Basin

Pit = Mine Pit

GW = Groundwater

TWRMF = Tailing and Waste Rock Management Facility

WQ = Water Quality samples will be collected at this location

Prepared by: HLH

Checked by: MRO

435,000 E

436,000 E

437,000 E

5,034,000 N

5,033,000 N

N

MEMOMINEE RIVER

PROPOSED CUT-OFF WALL

OXIDE TAILINGS AND WASTE ROCK MANAGEMENT FACILITY

FLOTATION TAILINGS AND WASTE ROCK MANAGEMENT FACILITY

TOPSOIL STOCKPILE

CONTACT WATER BASIN

OVERBURDEN/ GENERAL SOILS STOCKPILE

TOPSOIL STOCKPILE

CONTACT WATER BASIN

TOPSOIL STOCKPILE

GMW-5

GMW-3

MW18P

MW-2

LW-1

LW-3

CW-4

CW-3

LW-2

CW-5

CW-11

CW-9

CW-2

CW-8

CW-10

CW-1

LW-4

MW-8

CW-12

CW-7

CW-6

LEGEND

- APPROXIMATE PROPERTY LINE
- 220 — EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- DESIGNED PIT PERIMETER
- PROPOSED TAILINGS AND WASTE ROCK STORAGE AREA LIMITS
- PROJECT BOUNDARY
- MINERAL PROPERTY BOUNDARY
- PROPOSED STRUCTURE
- PROPOSED ROADWAY
- PROPOSED ROADWAY (BITUMINOUS)
- PROPOSED WATER TREATMENT DISCHARGE PIPELINE
- PROPOSED FENCE
- 230 — DESIGN CONTOUR
- GMW-3 — EXISTING GROUNDWATER MONITORING WELL NUMBER AND LOCATION
- LW-2 — PROPOSED LEACHATE MONITORING WELL NUMBER AND LOCATION
- CW-9 — PROPOSED COMPLIANCE MONITORING WELL NUMBER AND LOCATION
- PROPOSED CUT-OFF WALL

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. CURRENT PIT DESIGN SUPPLIED BY AQUILA RESOURCES INC. VIA EMAIL, MAY 2015.
4. WETLANDS CREATED FROM COMBINED FIELD SURVEYS SUPPLIED BY ERM IN JUNE 2011 AND STANTEC IN AUGUST 2015.
5. NATIONAL WETLAND INVENTORY (NWI) DOWNLOADED FROM MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION.
6. PLANT SITE FEATURES SUPPLIED BY LYCOPODIUM, JULY 2015.
7. STOCKPILE, CONTACT WATER AND PROCESSING AREA GRADES AND SLOPES ARE APPROXIMATE AND TO BE UPDATED BY FOTH.
8. GROUNDWATER ELEVATIONS WILL ALSO BE MONITORED AT ALL MONITORING WELLS SHOWN HERE.

FACILITY LAYOUTS SUBJECT TO CHANGE

100 0 100 200 300
SCALE 1:10,000 METERS

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	DRD	DATE:	JUN.'16
REVIEWED BY:	KKB	DATE:	JUN.'16
APPROVED BY:	KKB	DATE:	JUN.'16

BACK FORTY PROJECT

FIGURE 44-1
ENVIRONMENTAL MONITORING PLAN
GROUNDWATER QUALITY MONITORING
WELL LOCATIONS

Scale:	AS SHOWN	Date:	JUNE 2016
Drafted By:	JRB2	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\EMP\Response to MDEQ\EMP Fig 44-1 Water Quality Monitoring Well Locations.dgn
6/10/2016 bjw1

Attachment 45

Table 45-1

Phase 2 Postclosure Mine Years 17-30 Groundwater Monitoring and Sampling Locations

Well ID	Well Type	Facility
CW-3	Compliance Well	TWRMF
CW-4	Compliance Well	TWRMF
CW-5	Compliance Well	TWRMF
CW-11	Compliance Well	Pit
CW-12	Compliance Well	Former Processing Area
LW-13S	Leachate Well	Pit
LW-13D	Leachate Well	Pit
CW-14	Compliance Well	TWRMF
CW-15	Compliance Well	TWRMF
MW-2	Compliance Well	TWRMF and Pit
MW18P	Compliance Well	Pit
GMW-3	Compliance Well	Pit
GMW-5	Compliance Well	Pit
LW-1	Leachate Well	TWRMF
LW-2	Leachate Well	TWRMF
LW-3	Leachate Well	TWRMF
LW-5	Leachate Well	TWRMF

Abbreviations:
TWRMF = Tailings and Waste Rock Management Facility
Pit = Mine Pit

Prepared by: HLH
Checked by: MRO

435,000 E

436,000 E

437,000 E

5,034,000 N

5,033,000 N

N

MENOMINEE RIVER

BACKFILLED MINE PIT

TWRMF

GMW-5

GMW-3

MW18

MW-2

CW-13S

CW-13D

CW-11

CW-9

CW-8

CW-10

CW-1

CW-12

CW-2

CW-3

CW-4

CW-5

CW-6

CW-7

CW-14

CW-15

LW-1

LW-2

LW-3

LW-4

LW-5

LEGEND

- MINERAL PROPERTY LINE
- PROJECT BOUNDARY
- 220 EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- NWI NON-DELINEATED WETLAND
- PROPOSED ACCESS ROADS
- 230 DESIGN CONTOUR
- PROPOSED SEDIMENTATION BASIN
- PROPOSED DRAINAGE DITCH
- PROPOSED WETLAND
- PROPOSED CULVERT
- GMW-3 EXISTING MONITORING WELL LOCATION AND NUMBER
- MW18 EXISTING ERM MONITORING WELL LOCATION AND NUMBER
- CW-2 COMPLIANCE WELL LOCATION AND NUMBER TO BE ABANDONED
- LW-5 PROPOSED LEACHATE MONITORING WELL NUMBER AND LOCATION
- CW-14 PROPOSED COMPLIANCE MONITORING WELL NUMBER AND LOCATION

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. BACK FORTY PROJECT AREA WITHIN SECTION 1 AND 12, T35N, R29W, LAKE TOWNSHIP, MENOMINEE COUNTY, MICHIGAN.
4. PROPOSED CONTOURS REPRESENT FINAL RECLAMATION GRADES.
5. WETLANDS CREATED FROM COMBINED FIELD SURVEYS SUPPLIED BY ERM IN JUNE 2011 AND STANTEC IN AUGUST 2015.

80 0 80 160 240

SCALE 1:8,000 METERS

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	DRD	DATE:	JUN.'16
REVIEWED BY:	KKB	DATE:	JUN.'16
APPROVED BY:	KKB	DATE:	JUN.'16

BACK FORTY PROJECT

FIGURE 45-1

ENVIRONMENTAL MONITORING PLAN POSTCLOSURE MONITORING WELL LOCATIONS

Scale:	AS SHOWN	Date:	JUNE 2016
Drafted By:	JRB2	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\EMP\Response to MDEQ\EMP Fig 45-1 Post-Closure Monitoring Wells.dgn
6/10/2016 bjw1

Attachment 48

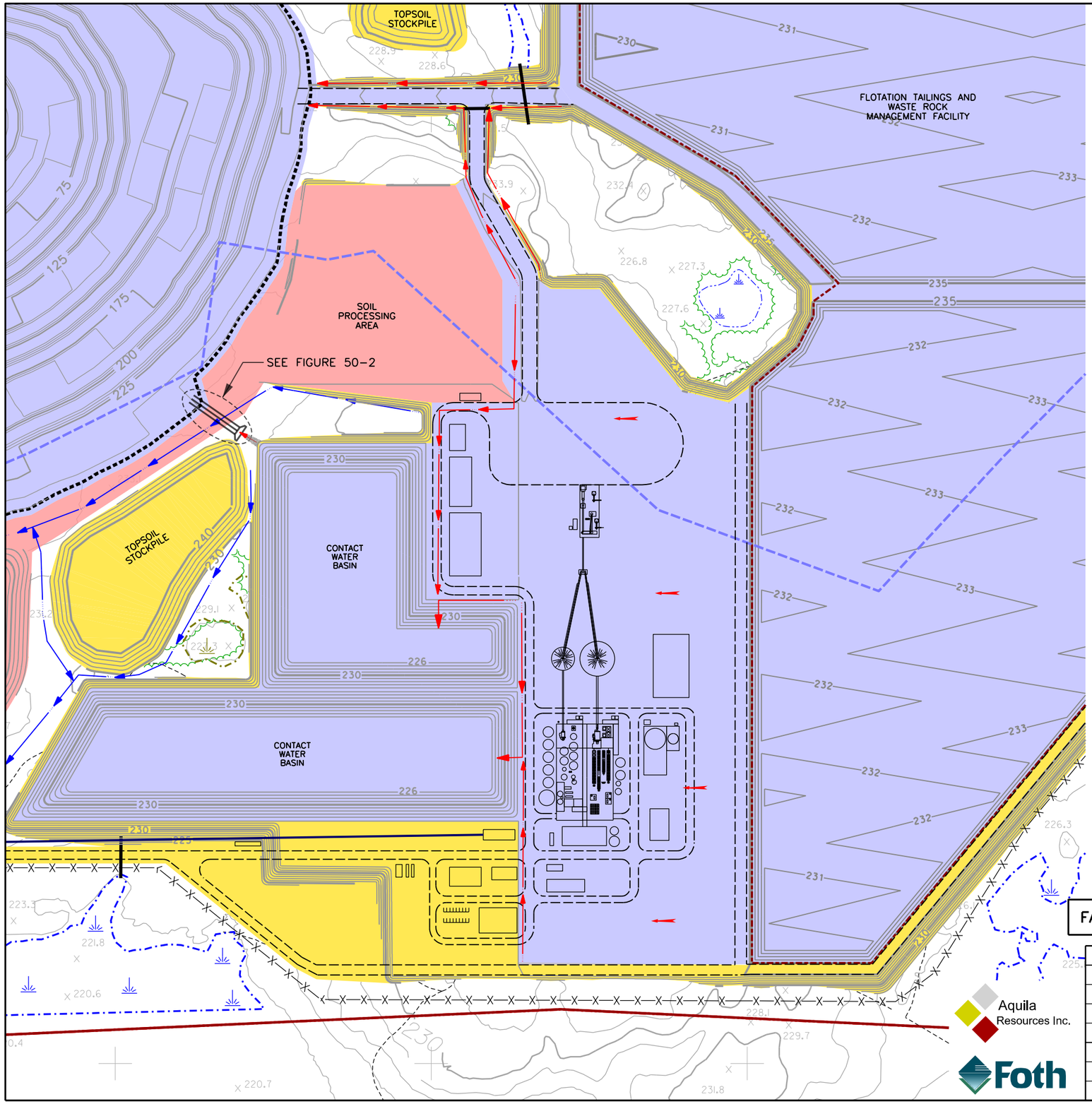
Table 48-1
TWRMF Postclosure
Leachate Generation

Postclosure Year	TOTAL Flow Rate (m^3/hr)	TOTAL Flow Rate (gpm)
1	32.5	143.1
10	1.976	8.70
20	0.969	4.26
30	0.668	2.94
40	0.491	2.16
50	0.276	1.22
55	0.260	1.14
60	0.253	1.11
65	0.245	1.08
70	0.237	1.04
75	0.225	0.99
80	0.211	0.93
85	0.193	0.85
90	0.173	0.76
95	0.152	0.67
100	0.132	0.58

Notes:
gpm = gallons per minute
m^3/hr = cubic meter per hour

Prepared by: MAN
Reviewed by: JOS1

Attachment 50



LEGEND

- EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- DESIGNED PIT PERIMETER
- WATERSHED BOUNDARY
- PROPOSED TAILINGS AND WASTE ROCK STORAGE AREA LIMITS
- PROJECT BOUNDARY
- MINERAL PROPERTY BOUNDARY
- PROPOSED STRUCTURE
- PROPOSED ROADWAY
- PROPOSED WATER TREATMENT DISCHARGE PIPELINE
- CONTACT WATER AREA (OXIDE AREA=163,941 SQ. M. FLOTATION AREA=759,242 SQ. M. MILL FACILITY AREA=280,333 SQ. M. MINE PIT AREA=349,395 SQ. M. TOTAL=1,510,338 SQ. M.)
- NON-CONTACT WATER AREA WITH BASIN (130,398 SQ. M. EAST), (30,169 SQ. M. WEST) TOTAL=160,567 SQ. M.
- NON-CONTACT WATER AREA WITHOUT BASIN
- NON-CONTACT WATER STORM WATER DITCH
- CONTACT WATER STORM WATER DITCH
- CONTACT WATER FLOW DIRECTION
- PROPOSED CULVERT

N

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. CURRENT PIT DESIGN SUPPLIED BY AQUILA RESOURCES INC. VIA EMAIL, MAY 2015.
4. WETLANDS SUPPLIED BY ERM IN OCTOBER, 2009.
5. NATIONAL WETLAND INVENTORY (NWI) DOWNLOADED FROM MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION.
6. PLANT SITE FEATURES SUPPLIED BY LYCOPODIUM, JULY 2015.
7. STOCKPILE, CONTACT WATER AND PROCESSING AREA GRADES AND SLOPES ARE APPROXIMATE AND TO BE UPDATED WITH THE PROJECT FINAL DESIGN.

FACILITY LAYOUTS SUBJECT TO CHANGE

40 0 40 80 120
SCALE 1:4,000 METERS

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	JSL	DATE: MAY '16
REVIEWED BY:	JOS1	DATE: MAY '16
APPROVED BY:	JOS1	DATE: MAY '16

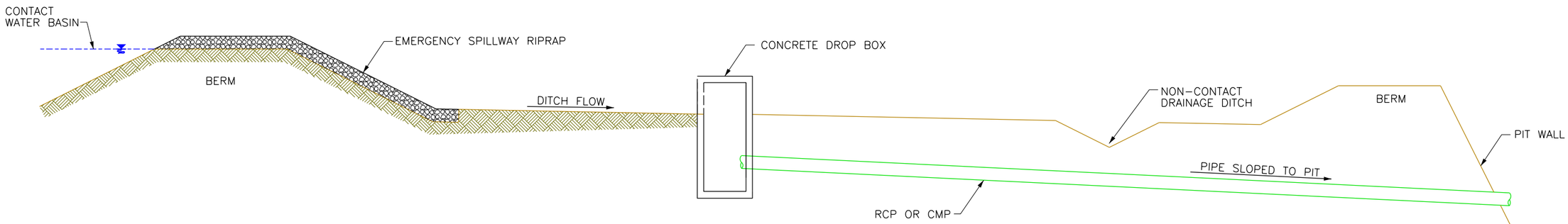
BACK FORTY PROJECT

FIGURE 50-1

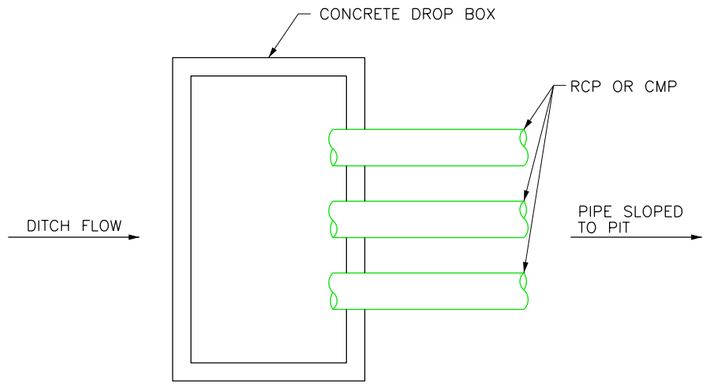
STORM WATER MANAGEMENT PLAN STORM WATER MANAGEMENT-OPERATIONS PHASE

Scale:	AS SHOWN	Date:	MAY 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\MDEQ response figures\Figure 50-1 Contact - Non Contact Areas.dgn
6/10/2016 bjw1



CONTACT WATER DISCHARGE CROSS SECTION



DROP BOX – PLAN VIEW

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	JSL	DATE:	MAY '16
REVIEWED BY:	JOS1	DATE:	MAY '16
APPROVED BY:	JOS1	DATE:	MAY '16

BACK FORTY PROJECT

FIGURE 50-2

CONTACT WATER DISCHARGE DETAIL

Scale:	NOT TO SCALE	Date:	MAY, 2016
Drafted By:	JOW	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\MDEQ response figures\Figure 50-2 Contact water discharge x-section.dgn
6/10/2016 bjw1

Attachment 54

Table 54-1

Michigan and Wisconsin Water Quality and Classification Definitions

Michigan		Wisconsin	
Menominee River Classification	All surface waters are designated and protected for agriculture, navigation, industrial water supply, warm water fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption, and total body contact recreation from May 1 to October 31. R 323.1100.	Menominee River Classification	Wisconsin NR 104.24 (3) states waste quality requirements and standards on the Menominee River shall meet the standards for recreational use and fish and aquatic life. Water quality standards are evaluated as Warmwater Sport Fish and Warm Water Forage (Non-Public Water Supply) (Personal communication, Jim Schmidt WDNR).
AMV Aquatic Maximum Value	Highest concentration of a material in ambient water column to which an aquatic community can be exposed briefly without resulting in unacceptable effects. R 323.1043(g)		
FAV Final Acute Value	Level of a chemical or mixture of chemicals that does not allow the mortality or other specified response of aquatic organisms to exceed 50% when exposed for 96 hours, except where a shorter time period is appropriate. R 323.1043 (gg)	ATC Acute Toxicity Criterion	Maximum daily concentration of a substance which ensures adequate protection of sensitive species of aquatic life from the acute toxicity of that substance and will adequately protect the designated fish and aquatic life from use of the surface water if not exceeded more than once every 3 years. NR 105.03 (2)
FCV Final Chronic Value	Level of a substance or a mixture of substances that does not allow injurious or debilitating effects in an aquatic organisms resulting from repeated long-term exposure to a substance relative to the organism's lifespan. R 323.1043 (hh)	CTC Chronic Toxicity Criterion	Maximum 4-day concentration of a substance which ensures adequate protection of sensitive species of aquatic life from the chronic toxicity of that substance and will adequately protect the designated fish and aquatic use of the surface water if not exceeded more than once every 3 years. NR 105.03 (15)
HCV Human Cancer Value	Maximum ambient water concentration of a substance at which a lifetime of exposure from either drinking the water, consuming fish from the water, and conducting water related recreation or consuming fish from the water and conducting water related recreation activities will represent a plausible upper bound risk of contracting cancer of 1 in 100,000 using exposure assumptions and methodology specified in R 323.1057 (4). Rule 57 shows drink and non-drink values. R 323.1043 (ll)	HCC Human Cancer Criterion	Maximum concentration of a substance or mixture of substances established to protect humans from an unreasonable incremental risk of cancer resulting from contact with or ingestion of surface waters of the states and from ingestions of aquatic organisms taken from the surface waters of the state. NR 105.09
HNV Human Noncancer Value	Maximum ambient water concentration of a substance at which adverse noncancer effects are not likely to occur in the human population from lifetime exposure through either drinking the water, consuming fish from the water, and conducting water-related recreation activities or consuming fish from the water and conducting water-related recreation activities using the exposure assumptions and methodology specified in R 323.1057(4). Rule 57 shows drink and non-drink values. R 323.1043 (mm)	HTC Human threshold Criteria	Maximum concentration of a substance established to protect humans from adverse effects resulting from contact with or ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state. NR 105.08
WV Wildlife Value	Maximum ambient water concentration of a substance at which adverse effects are not likely to result in population-level impacts to mammalian and avian wildlife populations form lifetime exposure through drinking water and aquatic food supply, using the methodology specified in R 323.1057 (3). R 323.1044 (ll)	WC Wildlife Criteria:	Concentration of a substance which if not exceeded, protects Wisconsin's wildlife from adverse effects resulting from ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state. NR 105.07

Notes: Definitions above are the first sentence in the rule or a summary. Refer to the rule for additional information.
Rules sited are Michigan: Part 4 Water Quality Standards; Wisconsin: Wisconsin Administrative Code Chapter NR 104 Uses and Designated Standards, and NR 105 Surface Water Quality Criteria and Secondary Values for Toxic Substances.

Prepared by: AKM
Checked by: MCC2

Table 54-2

Comparison of WWTP Effluent and Wisconsin Water Quality Criteria

Constituent	Estimated WWTP Effluent Concentration[1,2] (ug/L)	Draft Permit Limit (ug/L)	Menominee River Baseline Characteristics[5] (ug/L)	Michigan WQS [3] (ug/L)	Michigan WQS Basis	Wisconsin WQC [4] (ug/L)	Wisconsin WQC Basis
Antimony	29		0.5	130	HNV non drink	373	HTC
Arsenic	287	680	0.7	10	HCV non drink	13.3	HCC
Beryllium	3.6		0.6	3.3	FCV	0.3	HCC
Cadmium	9.7	21	0.13	2.4	FCV	2.7	CTC
Chromium	130.6		0.6	82	FCV	n.a.	
Chromium III	n.a.		n.a.	n.a.		146	CTC
Chromium VI	n.a.		n.a.	n.a.		10.98	CTC
Copper	30	46	0.6	9.9	FCV	11.5	CTC
Cyanide	0.1		2.6	5.2	FCV	11.5	CTC
Lead	440	600	0.5	23	FCV	31.5	CTC
Mercury	≤0.0013	0.0013	0.005	0.0013	WV	0.0013	WC
Nickel	253	1,200	1	58	FCV	57.9	CTC
Phosphorus	336	1,000	28	1000	[3]	100	[6]
Selenium	29	120	0.5	5	FCV	5	CTC
Silver	0.06		0.1	0.06	FCV	28000	HTC
Zinc	273	550	6.6	130	AMV	134	ATC, CTC

Prepared by: AKM
Checked by: MCC2

Notes:

[1] The constituents listed have individual water quality standards in Wisconsin. Other constituents would likely be regulated in a composite approach by requiring a whole effluent toxicity (WET) test. (WDNR personal communication, May 13, 2016).

[2] Estimated effluent concentrations are based on a combination of facility water quality estimate and the treatment needed to comply with Michigan Preliminary Effluent limitations based on Part 31 of NREPA Water Resources Protection, Part 8 Water Quality-Based Effluent Limit Development for Toxic Substances. Concentrations for cadmium, copper, lead, mercury, silver, and zinc are maximum values. The remaining constituents are shown as average annual concentrations and may be higher for certain durations, however, with a maximum of the applicable permit limit.

[3] Michigan WQS evaluated on the basis of Rule 57 Surface Water Criteria with the exception of phosphorus, which is based on R 323.1060. Average hardness of 113 mg/L was used to estimate the WQS of beryllium, cadmium, copper, lead, nickel, and zinc.

[4] Wisconsin WQC evaluated on the basis of a warm water sport fish and warm water forage (non-public water supply) in the Great Lakes Basin. Average hardness of 113 mg/L was used to estimate the WQC of cadmium, chromium III, copper, lead, nickel, and zinc.

[5] With the exception of hardness, water quality characteristics at MSG-10 are represented as a geometric mean of 8 quarters of water quality samples collected between 2007 and 2009. Half the value of detection level were estimated for non-detections. The hardness value of 113 mg/L is the average of 8 quarters of data.

[6] Wisconsin phosphorus WQC is based on Wisconsin Administrative Code Ch. NR 102.06(3)(a).

Abbreviations:

AMV - Michigan aquatic maximum value
FCV - Michigan final chronic value
HCV - Michigan human cancer value
HNV - Michigan human noncancer value
ATC - Wisconsin acute toxicity criterion
CTC - Wisconsin chronic toxicity criterion
HCC - Wisconsin human cancer criterion
HTC - Wisconsin human threshold criterion
NREPA -Michigan Natural Resources and Environmental Protection Act
n.a. - not available or not applicable
ug/L - microgram per liter
WC - Wisconsin wildlife criterion
WDNR - Wisconsin Department of Natural Resources
WQC - water quality criterion
WQS - water quality standard
WV - Michigan wildlife value
WWTP - wastewater treatment plant

Attachment 61

Table 5-1
Surface Water Monitoring and Sampling Locations

Surface Water Description	Sample Location	Description of Location Relative to Project Area	Measurement or Samples[1]
Menominee River	MSG-13	Upstream	Water elevation, flow, and water quality sample
Menominee River	MSG-10	Adjacent	Water quality sample
Menominee River	MSG-14	Downstream	Water elevation, flow, and water quality sample
Shakey River	MSG-7	Upstream	Water elevation, flow, and water quality sample
Shakey River	MSG-3	Downstream	Water elevation, flow, and water quality sample
Long Lake	MSG-1	Downstream	Water elevation, flow, and water quality sample

[1] Water quality parameter list and frequency is provided on Table 2-1.

Prepared by: AKM

Checked by: HLH

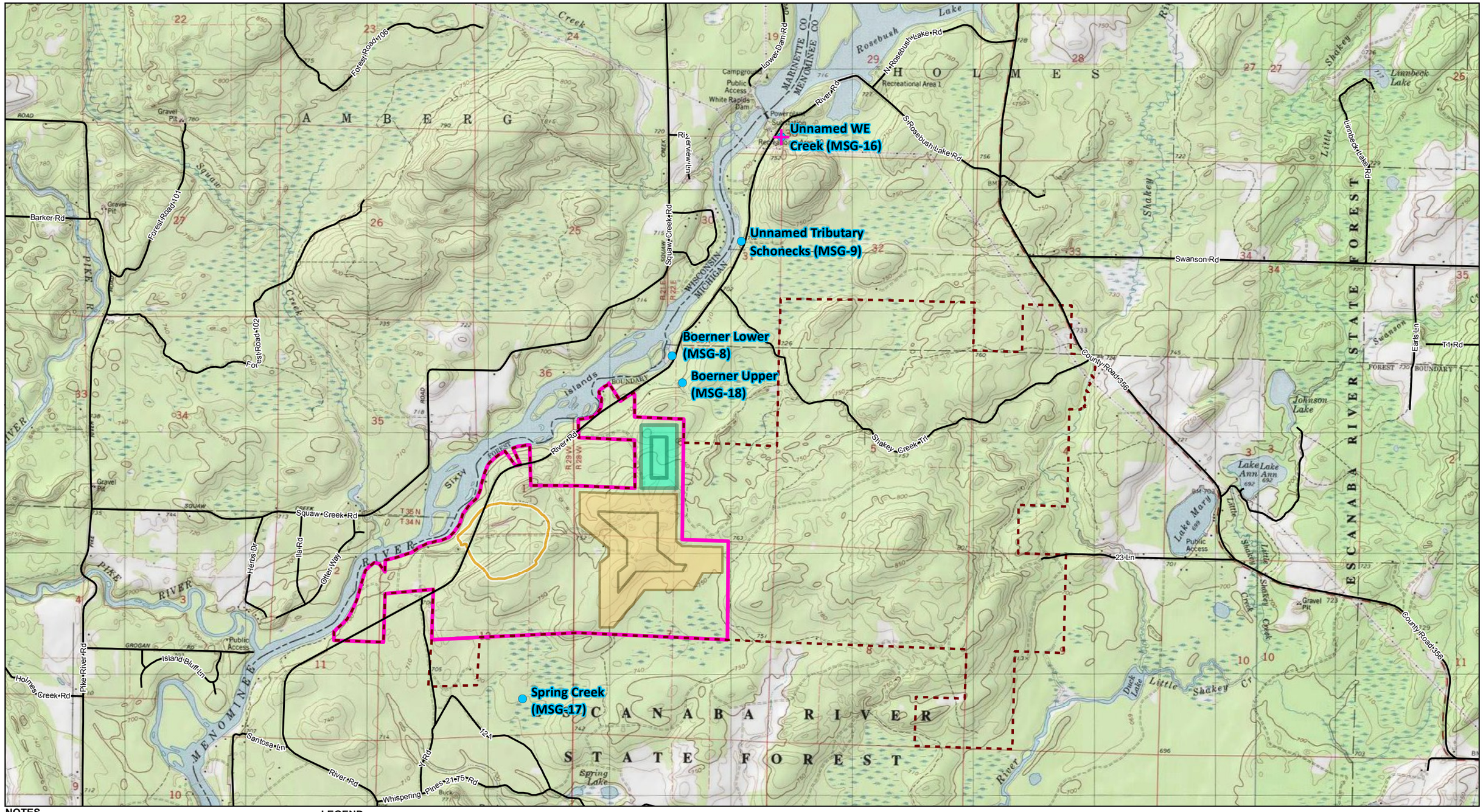
Table 9-3
Phase 2 Postclosure Mine Years 17-30 Surface Water Monitoring Locations

Surface Water Description	Station ID	Description of Location Relative to Mine	Measurement or Samples
Menominee River	MSG-13	Upstream	Water elevation and water quality sample
Menominee River	MSG-10	Adjacent	Water quality sample
Menominee River	MSG-14	Downstream	Water elevation and water quality sample

Notes:
Surface water sampling/gauging locations from ERM September 2011, Figure 2.4 and Table 2.1.
Abbreviations:
ID = Identification
MSG = Michigan surface water sampling location

Prepared by: AKM
Checked by: HLH

Attachment 63



NOTES

1. Topographic basemap from Esri and its data suppliers. Topographic contours shown in feet above mean sea level.
2. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
3. Current pit design supplied by Aquila via email in May 2015.
4. One year of additional water quality monitoring and macroinvertebrate surveys proposed for additional monitoring locations shown in this figure.

LEGEND

- Proposed Additional Surface Water Quality Monitoring Site
- Stream Gaging Station
- Designed Pit Perimeter
- Mineral Property Boundary
- Project Boundary
- Roads
- Flotation TWRMF
- Oxide TWRMF

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC				BACK FORTY PROJECT
REVISED	DATE	BY	DESCRIPTION	
				FIGURE 63-1 MDEQ PROPOSED ADDITIONAL SURFACE WATER QUALITY SAMPLING SITES STEPHENSON, MICHIGAN
PREPARED BY: JSL			DATE: MAY '16	Scale: 0 300 600 1:30,000 Meters / Date: MAY 2016
REVIEWED BY: AKM			DATE: MAY '16	
APPROVED BY: DRD			DATE: MAY '16	Drafted by: DAT / Project No: 14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\EIA\Response\Figure 63-1 Proposed Additional SW Sampling Sites.mxd Date: 6/7/2016

Attachment 66

Table 66-1
Macroinvertebrate Data

Site		AQ 1		AQ 2		AQ 3		AQ 4		AQ 5		AQ 6		AQ 7		AQ 8		AQ 9		AQ 10	
Location		Menominee River		Menominee River		Menominee River		Shakey River		Resort Lake		East Lake		Baker Lake		Shakey River		Little Shakey Creek		Shakey River	
Beginning Lat/Long		45.551262917, -87.830380061		45.457103705, -87.831375774		45.413609145, -87.852208037		45.417427454, -87.85197151		45.425979637, -87.829832198		45.422110493, -87.815894139		45.417945271, -87.810504399		45.425636321, -87.776241228		45.444871588, -87.749344888		45.456468294, -87.773185314	
Ending Lat/Long		45.546427056, -87.813181535		45.444303581, -87.847350651		45.39980247,-87.858044		45.416690133, -87.853072359								45.425549929, -87.777.32583		45.444303889, -87.749439669		45.455886039, 87.772768085	
Year		2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Water Quality																					
Date Sampled		**8/19/2008**	**8/10/2009**	**8/20/2008**	**8/11/2009**	**8/21/2008**		**8/3/2008**	**7/16/2009**	**7/31/2008**	**8/12/2009**	**8/4/2008**		**8/4/2008**	**8/12/2009**	**8/5/2008**	**7/15/2009**	**8/2/2008**	**7/15/2009**	**8/1/2008**	**7/14/2009**
Temperature	°C	23.7	24.3	25.3	24.6	23		27.2	21.3	20.9	20.2	23.4		26.8	26.4	26.3	25.6	20.6	19.8	19.2	18.2
Dissolved Oxygen	mg/L	8.2	8.3	8.9	10	8.6		11.3	12.2	6.1	5.6	6.9		11.3	8.7	9	9.9	7.2	6	8.9	10.2
pH	S.U.	8.09	8.5	8	8.6	8		8.6	8.8	7.3	7.8	7.7		7.5	9	7.6	8.5	7.6	7.8	7.8	8
Conductivity	u mhos/cm	261	288	254	285	255		305	383	317	291	351		233	230	385	432	390	409	398	256
Ammonia as Nitrogen	mg NH3-N/L	< 0.020	< 0.020	< 0.020	0.035	< 0.020		0.049	< 0.020	< 0.020	0.028	< 0.020		< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Nitrogen, Nitrate-Nitrite	mg/L	0.044	< 0.020	0.039	< 0.020	0.028		< 0.020	< 0.020	< 0.020	< 0.020*	< 0.020		< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.024	< 0.020	< 0.020
Nitrogen, Total Kjeldahl	mg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0*	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phosphorus, Total	mg/L	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050		< 0.050	< 0.050	< 0.050	< 0.050*	< 0.050		< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Suspended Solids	mg/L	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0		< 6.0	9.5	< 6.0	20*	< 6.0		< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	8	< 6.0	8
Macroinvertebrates																					
Shakey River/Shakey Creek																					
Date Sampled								**8/4/2008**		**7/18/2009**						**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
								Value	**Score**	**Value**	**Score**					**8/5/2008**		**7/15/2009**		**8/2/2008**		**7/15/2009**		**8/1/2008**		**7/14/2009**	
TOTAL TAXA								25	0	31	1					18	0	24	0	25	0	30	1	32	1	24	0
# EPHEMEROPTERA FAMILIES								3	0	2	-1					0	-1	2	-1	4	0	6	1	4	0	3	0
# TRICHOPTERA FAMILIES								1	-1	5	0					3	0	3	0	4	0	4	0	6	1	4	0
# PLECOPTERA FAMILIES								0	-1	0	-1					0	-1	0	-1	1	0	1	0	1	0	1	0
% OF EPHEMEROPTERA FAMILIES								12	0	6.5	0					0	-1	8.3	0	16	0	20	0	12.5	0	12.5	0
% OF TRICHOPTERA FAMILIES								4	0	16.1	0					16.7	0	12.5	0	16	0	13.3	0	18.8	0	16.7	0
% DOMINANCE								54.2	-1	48.3	-1					36.2	-1	28.1	-1	23.7	0	20	0	21.3	0	24.6	0
% ISOPOD,SNAIL,LEECH								2	1	11.3	0					0.5	1	0.9	1	0.4	1	2.9	1	0.4	1	0	1
% SURFACE DEPENDENT								3.9	1	2.3	1					10.3	0	20.7	-1	1.7	1	1.3	1	2.5	1	1.1	1
TOTAL SCORE									**-1**		**-1**						**-3**		**-3**		**2**		**4**		**4**		**2**
Menominee River Sampling																					
Date Sampled		**8/19/2008**		**8/10/2009**		**8/20/2008**		**8/11/2009**		**8/21/2008**											
		Value	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**										
TOTAL ABUNDANCE		546		501		507		525		565											
TOTAL RICHNESS		28		21		25		32		31											
# EPHEMEROPTERA FAMILIES		4		3		6		4		4											
# PLECOPTERA FAMILIES		0		0		0		0		1											
# TRICHOPTERA FAMILIES		1		1		8		7		3											
# DIPTERA TAXA		3		2		1		4		4											
TRICHOPTERA ABUNDANCE		3		10		39		32		51											
ABUNDANCE OF DOMINANT TAXON		354		331		152		180		177											
SHREDDER ABUNDANCE		388		346		157		203		196											
SCRAPER ABUNDANCE		31		16		55		17		6											
COLL-FILTERER ABUNDANCE		3		0		19		7		53											
COLL-GATH ABUNDANCE		41		27		237		139		267											
PREDATOR ABUNDANCE		83		112		39		159		43											
FFG Diversity (25)		1.32	8	1.24	8	1.85	25	1.8	25	1.71	25										
Habitat Stability FFG Surrogate (25)		0.08	0	0.04	0	0.19	8	0.07	0	0.13	8										
% Trichoptera (20)		0.55	0	2	7	7.69	20	6.1	14	9.03	20										
EPT Richness (8)		5	3	4	3	14	8	11	8	8	6										
Total Richness (7)		27	7	21	5	25	7	31	7	30	7										
Diptera Richness (5)		3	2	2	2	1	0	4	4	4	4										
Plecoptera Richness (5)		0	0	0	0	0	0	0	0	1	2										
% Dominance (5)		69.23	0	66.07	0	29.98	5	35.81	4	31.33	5										
Total Score			**20**		**25**		**73**		**62**		**77**										
Shakey Lake										**7/31/2008**	**8/12/2009**	**8/4/2008**		**8/4/2008**	**8/12/2009**						
Date Sampled										**Value**	**Value**	**Value**		**Value**	**Value**						
TOTAL ABUNDANCE										498	509	608		529	509						
TOTAL RICHNESS										19	24	24		22	23						
# EPHEMEROPTERA FAMILIES										3	3	2		3	4						
# TRICHOPTERA FAMILIES										3	4	3		2	3						
# ODONATA FAMILIES										2	3	3		4	3						
% OF EPHEMEROPTERA FAMILIES										15.8	12.5	8.3		13.6	17.4						
% OF TRICHOPTERA FAMILIES										15.8	16.7	12.5		9.1	13						
% ODONATA FAMILIES										10.5	12.5	12.5		18.2	13						
%ETO										42.1	41.7	33.3		40.9	43.5						
% DOMINANT FAMILY										32.7	46.8	57.4		55	65						
% Crustaceans and Mollusks										46.2	34.2	59.7		56.5	68.2						
Shannon-Wiener Diversity Index (H')										2.1	1.69	1.75		1.61	1.52						
FBI Score										6.35	6.69	7.08		6.81	7.25						
Index of Biological Integrity										31	29	26		26	26						

Attachment 68

Table 68-1
Algal Diversity Indices

Index Name-Algae	Formula	Explanation of Variables	Level of Analysis	Groups Calculated for
Shannon Index-standard ($H^{'}$, Shannon Weaver) SHST	$-\sum p_i * \ln p_i$ e.g. SHSTRCONC	p_i is the relative proportion of each taxa (taxa/total sample taxa). This is summed for all unique taxa in the sample	Species and Genus	All taxa in Macro, Zoop, and Algae PLUS Algae:Division Bacillariophyta
Richness	S Taxacount	S is the total number of unique taxa	Species and Genus	All taxa in Macro, Zoop, and Algae PLUS Algae:Division Bacillariophyta
α (alpha)	α= (N*(1-x))/x, where: S/N=((1-x)/x)*(-ln*(1-x)), this is an iterative process until you determine x	S is the total number of unique taxa, N is the total number of individuals within each taxa summed (e.g. total sample concentration, total sample biovolume, etc)	Species and Genus	All taxa in Macro, Zoop, and Algae PLUS Algae:Division Bacillariophyta
Pollution Tolerance Index	$(\sum n_i * PTClass)/N$	n_i is the concentration of each taxa, (e.g. taxa/mL), PTI is the value for the Pollution Tolerance Index, N is the total number of individuals within each taxa summed (e.g. total sample concentrantion, total sample biovolume, etc)	Species and Genus	All taxa in Macro, Algae:Division Bacillariophyta
Siltation Index-standard	$\sum p_i$ of Motile Genera	p_i is the relative proportion of each taxa (taxa/total sample taxa). Motile Genera are Navicula, Nitzschia, Surirella and Cylindrotheca	Species and Genus	Algae:Division Bacillariophyta Only
RA Sensitive Diatoms	∑pi of taxa with PTClass=3	pi is the relative proportion of each taxa (taxa/total sample taxa).	Species or Genus	Algae:Division Bacillariophyta Only
Salinity Index	See Attachment for calculation basis. Delta Environmental Consulting, based on VanDam (1994) and Van Dam, Mertens and Sinkeldam (1994)	p_i is the relative proportion of each taxa (taxa/total sample taxa).	Genus	Algae:Division Bacillariophyta Only

Table 68-1 (*Continued*)

Index Name-Algae	Formula	Explanation of Variables	Level of Analysis	Groups Calculated for
Oxygen Index	See Attachment for calculation basis. Delta Environmental Consulting, based on VanDam (1994) and Van Dam, Mertens and Sinkeldam (1994)	pi is the relative proportion of each taxa (taxa/total sample taxa).	Genus	Algae:Division Bacillariophyta Only
Trophic Index	See Attachment for calculation basis. Delta Environmental Consulting, based on VanDam (1994) and Van Dam, Mertens and Sinkeldam (1994)	pi is the relative proportion of each taxa (taxa/total sample taxa).	Genus	Algae:Division Bacillariophyta Only
Saprobity Index	See Attachment for calculation basis. Delta Environmental Consulting, based on VanDam (1994) and Van Dam, Mertens and Sinkeldam (1994)	pi is the relative proportion of each taxa (taxa/total sample taxa).	Genus	Algae:Division Bacillariophyta Only

reproductive or resting stages).

Attachment 69

Table 69-1

Periphyton, Algal, Plankton Sample Dates

Sample Location	Sample Date	Analyses
AQ1	8/19/2008	Microalgae, Macroalgae
	8/10/2009	Microalgae, Macroalgae
AQ2	8/20/2008	Microalgae, Macroalgae
	8/11/2009	Microalgae, Macroalgae
AQ3	8/21/2008	Microalgae, Macroalgae
AQ4	8/3/2008	Microalgae, Macroalgae
	7/16/2009	Microalgae
	8/13/2009	Macroalgae
AQ5	7/31/2008	Phytoplankton, Zooplankton
	8/12/2009	Phytoplankton, Zooplankton
AQ6	8/4/2008	Phytoplankton, Zooplankton
AQ7	8/4/2008	Phytoplankton, Zooplankton
	8/12/2009	Phytoplankton, Zooplankton
AQ8	8/5/2008	Microalgae, Macroalgae
	7/15/2009	Microalgae
	8/13/2009	Macroalgae
AQ9	8/2/2008	Microalgae, Macroalgae
	7/15/2009	Microalgae
	8/13/2009	Macroalgae
AQ10	8/1/2008	Microalgae, Macroalgae
	7/14/2009	Microalgae
	8/13/2009	Macroalgae

Attachment 70

(Provided on CD)

Attachment 71

Figure 71-1
Test Method: Generic Diatom Indices

Generic diatom indices http://www.deltaenvironmental.com.au/management/Lab_methods/Generi...

TEST METHOD: GENERIC DIATOM INDICES

Revised: 30 May 2007 (first issue)

RISK ASSESSMENT

Assess the Quality, Safety and Environmental risks of each step.

OVERVIEW

Diatom assemblage data from waterbodies such as rivers, streams, wetlands, estuaries and salinas may be used to assess water quality. Assemblages of pollution/salinity/dessication tolerant diatoms may be used as an early indicator of a deterioration in water quality or quantity. The following indices are based on identification to genus. Raw data at species level may be amalgamated for use with the indices.

While using indices based on generic level taxonomy reduces the time and taxonomic expertise levels required, identification should ideally be carried out to the lowest level possible. Ecological preference data exists for a sizeable percentage of species and this information may provide further insights into the habitat.

TASK SAFETY REQUIREMENTS

Delta dress code applies

PRINCIPLE OF METHOD

Data collected using the diatom sampling and identification method may be assessed with these indices. The data is collated and input as "% relative abundance" of different genera. Not all genera will be used in the indices, as many genera are indifferent to pollution, or have mixed responses from member species. Genera that contain a small number of species are also excluded. Those genera assessed by Van Dam (1994) as either specifically **tolerant** or **sensitive** are used.

Indices have been developed for various impacts; salinity, pH, oxygen requirement, N metabolism, trophic state (inorganic N & P concentrations), saprobity (organic enrichment with biological oxygen demand) and dessication. The most useful index will vary, depending on what impact you are assessing. Refer to Van Dam, Mertens and Sinkeldam (1994), "A coded checklist and ecological indicator values of freshwater diatoms from The Netherlands" for an explanation of the derivation of the impact indices.

INDICATOR GENERA

	Salinity Index (freshwater)	Acid (low pH) Index	Oxygen requirement Index	N metabolism Index	Trophic Index	Saprobity Index	Dessication Index
Sensitive genera	*Achnanthes*	*Amphora*	*Achnanthes*	*Achnanthes*	*Achnanthes*	*Achnanthes*	*Aulacoseira*
	Aulacoseira	*Caloneis*	*Cymbella*	*Amphora*	*Aulacoseira*	*Aulacoseira*	*Cocconeis*
	Cymbella	*Cocconeis*	*Diploneis*	*Aulacoseira*	*Cymbella*	*Cocconeis*	*Cyclotella*
	Eunotia	*Cyclotella*	*Eunotia*	*Cyclotella*	*Eunotia*	*Cymbella*	*Diatoma*
	Gomphonema	*Diatoma*	*Fragillaria*	*Cymbella*	*Neidium*	*Eunotia*	*Fragillaria*
	Neidium	*Diploneis*	*Gomphonema*	*Diatoma*	*Pinnularia*	*Neidium*	*Neidium*
	Pinnularia	*Fragilaria*	*Neidium*	*Eunotia*	*Stauroneis*	*Pinnularia*	*Surirella*
	Stauroneis	*Nitszchia*		*Neidium*		*Stauroneis*	
		Surirella		*Pinnularia*		*Surirella*	
				Stauroneis			
				Surirella			
Tolerant genera	*Amphora*	*Eunotia*	*Cocconeis*	*Cocconeis*	*Amphora*	*Amphora*	*Diploneis*
	Mastogloia	*Neidium*	*Cyclotella*	*Melosira*	*Cocconeis*	*Cyclotella*	*Eunotia*
	Nitszchia	*Pinnularia*	*Nitszchia*	*Nitszchia*	*Diatoma*	*Diatoma*	*Hantzschia*
	Surirella				*Nitszchia*	*Melosira*	*Pinnularia*
						Nitszchia	*Stauroneis*

CALCULATION

For each sample, record the % relative abundance of genera used in the selected Index.

Sum the % relative abundances of the sensitive genera. Sum the % relative abundances of the tolerant genera.

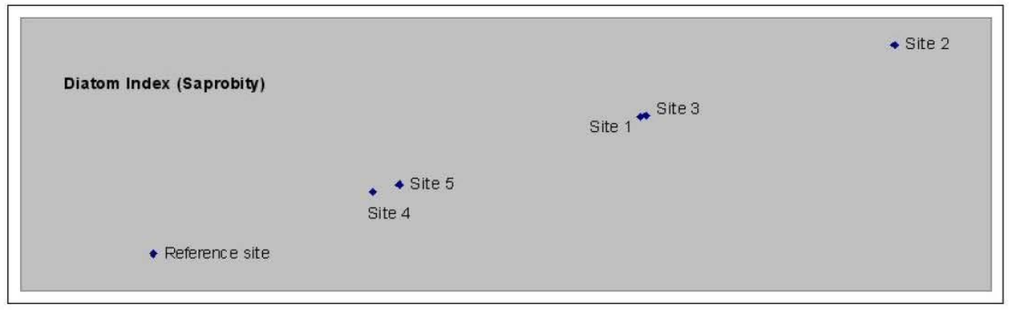
$$Index = \frac{\Sigma sensitive}{\Sigma tolerant}$$

Plot the resulting indices for sample sites and reference sites, against themselves, on an XYplot to see any clustering.

WORKED EXAMPLE

Generic Index (based on Van Dam) of Saprobity

Name	Site 1	Site 2	Site 3	Site 4	Site 5	Reference site
Achnanthes	7.43%	4.21%	21.50%	15.63%	13.92%	1.58%
Aulacoseira						
Cocconeis	18.24%	27.20%	9.03%	8.68%	12.09%	6.31%
Cymbella						
Eunotia						
Neidium						
Pinnularia						
Stauroneis						
Surirella	0.00%	0.00%	0.93%	0.00%	0.00%	0.32%
Score (pollution sensitive)	**25.68%**	**31.42%**	**31.46%**	**24.31%**	**26.01%**	**8.20%**
Amphora	13.51%	14.18%	8.72%	20.49%	31.50%	27.44%
Cyclotella	10.14%	2.68%	4.36%	10.42%	5.13%	1.26%
Diatoma						
Melosira	0.34%	0.00%	0.93%	0.35%	0.00%	0.32%
Nitzschia	4.73%	8.05%	20.87%	16.67%	10.99%	13.88%
Score (pollution tolerant)	**28.72%**	**24.90%**	**34.89%**	**47.92%**	**47.62%**	**42.90%**
Generic Index score	**0.89**	**1.26**	**0.90**	**0.51**	**0.55**	**0.19**



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Attachment 72

(Provided on CD)

Attachment 73

Table 73-1
Periphyton, Algal, Plankton Sample Dates

Sample Location	Sample Date	Analyses
AQ1	8/19/2008	Microalgae, Macroalgae
	8/10/2009	Microalgae, Macroalgae
AQ2	8/20/2008	Microalgae, Macroalgae
	8/11/2009	Microalgae, Macroalgae
AQ3	8/21/2008	Microalgae, Macroalgae
AQ4	8/3/2008	Microalgae, Macroalgae
	7/16/2009	Microalgae
	8/13/2009	Macroalgae
AQ5	7/31/2008	Phytoplankton, Zooplankton
	8/12/2009	Phytoplankton, Zooplankton
AQ6	8/4/2008	Phytoplankton, Zooplankton
AQ7	8/4/2008	Phytoplankton, Zooplankton
	8/12/2009	Phytoplankton, Zooplankton
AQ8	8/5/2008	Microalgae, Macroalgae
	7/15/2009	Microalgae
	8/13/2009	Macroalgae
AQ9	8/2/2008	Microalgae, Macroalgae
	7/15/2009	Microalgae
	8/13/2009	Macroalgae
AQ10	8/1/2008	Microalgae, Macroalgae
	7/14/2009	Microalgae
	8/13/2009	Macroalgae

Attachment 75

Table 75-1
2009 Fish Contaminant Sample Species and Length

Sample Location	Sample #	Species (common name)	Length (inch)
AQ1	1	smallmouth bass	15
	2	smallmouth bass	14
	3	silver redhorse sucker	12
	4	silver redhorse sucker	18
	5	silver redhorse sucker	18
	6	silver redhorse sucker	11
AQ2	1	shorthead redhorse sucker	15
	2	shorthead redhorse sucker	16
	3	shorthead redhorse sucker	16
	4	shorthead redhorse sucker	17
	5	shorthead redhorse sucker	14
	6	shorthead redhorse sucker	15
	7	shorthead redhorse sucker	16
	8	shorthead redhorse sucker	17
	9	shorthead redhorse sucker	17
	10	shorthead redhorse sucker	20
	11	shorthead redhorse sucker	17
	12	shorthead redhorse sucker	18
AQ5	1	largemouth bass	12
	2	largemouth bass	12
	3	largemouth bass	13
	4	largemouth bass	14
	5	black bullhead	9
	6	black bullhead	9
	7	black bullhead	9
	8	black bullhead	9
	9	black bullhead	7
	10	brown bullhead	11
	11	brown bullhead	11
	12	brown bullhead	10
	13	brown bullhead	9
AQ7	1	largemouth bass	12
	2	largemouth bass	12
	3	largemouth bass	13
	4	largemouth bass	13
	5	largemouth bass	17
AQ10	1	brook trout	9
	2	brook trout	10
	3	brook trout	10

Attachment 79

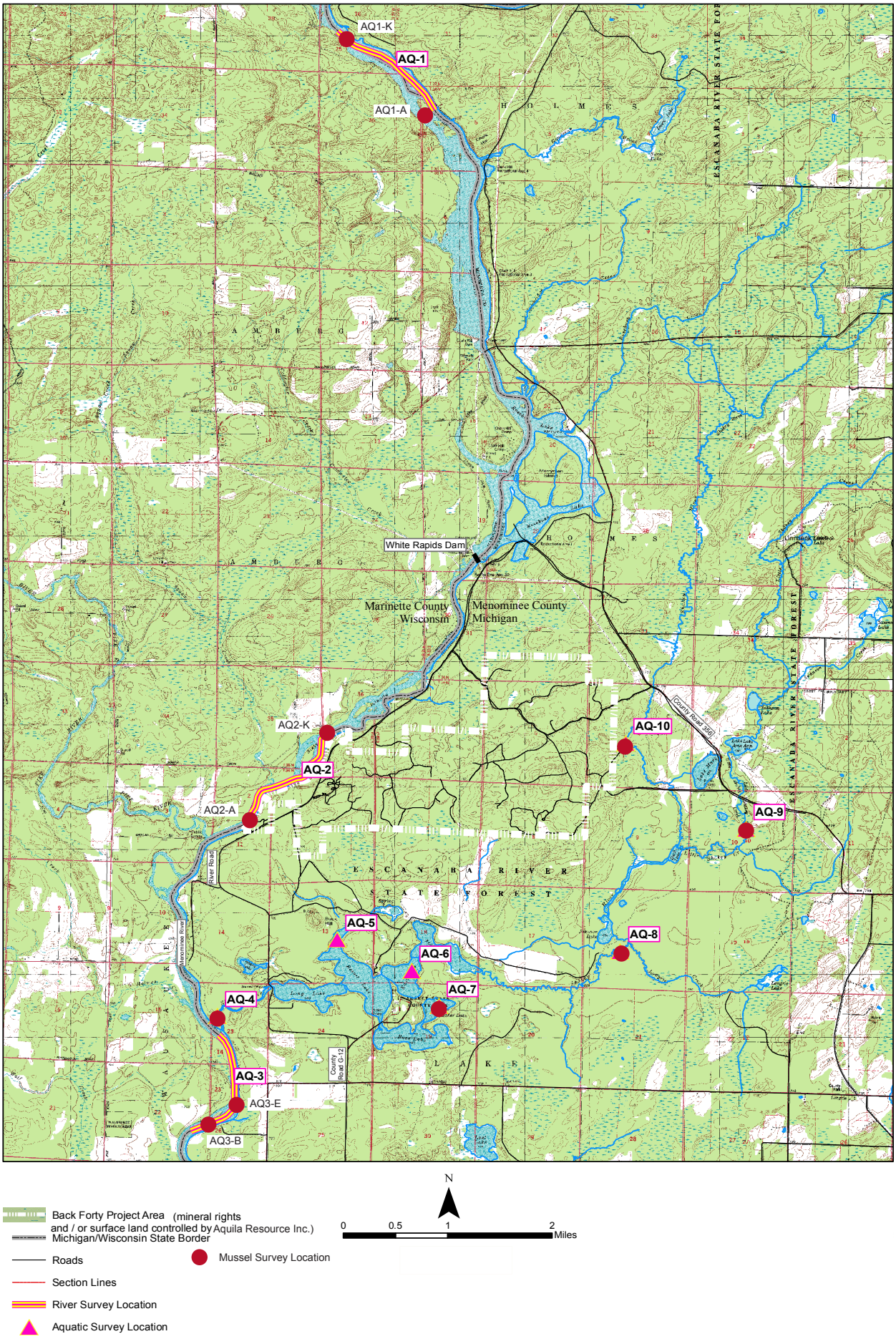

Figure 1. Locations of unionid mussel survey sites.

Attachment 82

...ironmental Resources Management, Inc.
...128th Avenue
Holland Michigan 49424
616.399.3500
616.399.3777 (fax)

T36 R29W S 36, 25

ERM

FISH SAMPLING DATA SHEET

Date: 6/25/9

Water body: Menominee River **Location:** Pembine, WI

Sample Station ID AQ 1 **Bank Sampled (River Only; looking upstream R or L):** R and L

Collectors: B. Rabe, M. Baker, J. Williams

GPS Start (Include datum): [UTM, NAD83] *See below **GPS End:** *See below

Sampling Start Time: 1240 **Sampling End Time:** 1700

Gear Type: Boom shocker / seine **Gear Comments:** TOTAL SHOCK TIME = 3,631 sec. = 60.5 MIN

Weather Conditions: Partly cloudy; light rain; 82°F

Conductivity: (umhos) 269 @ 26.3°C **Secchi reading (ft):** ____

Calibration => slope: 1.020 => 1405 @ 25.4°C (standard 1413)
meter #2

Comments/Notes:

1300 stop 1 595 sec [GPS AQ1 stop1] ; PW = 3.5, 60pps, 530V (switch to 707 V)

1342 stop2 707 sec ; PW: 3, 60pps, 707 V

1425 stop3 818 gps 021 same settings

1435 stop4 gps 022 694 sec "

1625 stop5 821 sec "

Swim 1X @ GPS AQ1 Seine 1

GPS START 1 = 16T 435144, 5045225 / GPS STOP 1 = 16T 435522, 5044817
GPS START 2 = 16T 435522, 5044817 / GPS STOP 2 = 16T 436002, 5044488
GPS START 3 = 16T 436002, 5044488 / GPS STOP 3 = 16T 436386, 5043980
GPS START 4 = 16T 436623, 5044076 / GPS STOP 4 = 16T 436316, 5044498
GPS START 5 = 16T 436316, 5044498 / GPS STOP 5 = 16T 435503, 5045099

Notes: only 1 seine performed. Not many areas to seine w/out excessive woody debris, too steep of bank/bottom slope, or too many weeds.

Fish Contaminant Samples: (2) SM Bass, (4) Silver Redhorse

Waterbody: Menominee River
Date 6/5/9 **Station ID:** AQ1
Gear: Boom shocker / Seine
Collectors: B. Baker, M. Baker, J. Williams

Species: (number)	Common Shiner	Silver Redhorse	Black Bullhead	Smallmouth Bass	Yellow Perch	Brown Bullhead	Golden Redhorse	Bluegill	White Sucker	Black Buffalo
• all species 175 feet by inch class	2	10	10	9 (1)	5	9	23 (2)	8	12 (4)	9
	3	10	10	18	5	10	19 (3)	7		8
	3 (1)	• 12	11 (1)	9 (2)	7	10		7		9
	2	10 (1)	9	• 15 (3)	7 (3)	9 (2)		6 (2)		9
	2 (2)	• 18 (2)	10	• 14 (5)	7 (3)	10		7		11
	2 (5)	• 18	10		12	9		8 (4)		9
		• 11 (3)	10		8	10		5		9
			9		5	11		7		7
			10		7	11		7		10
			10		5	9		7		7 (4)
			9		5	8 (4)		5		11
			10		5 (4)	10		6 (5)		9
			9		5	10				8
			11		7	10				9
			8		4	10				9
			9		7	10				10
			10		4	9				9
			9		9 (5)	9				9
			11 (2)			10				5
			9 (1)			7				10
			11			11				9
			10			11				10
			9			10				12
			9			8				9
			9			11				9
			9			8				9
Total:	6	7	57 *	5	18	27	2	12	1	*

Waterbody: Menominee River

Date 6/25/9 **Station ID:** AQ 1

Gear: Boom shocker / Seine

Collectors: B. Labe, M. Baker, J. Williams

red tail

SEINE GPS AQ1 Seine 1

Species:	Pumpkinseed	Rock bass	Golden shiner	Black Bullhead	Brown Bullhead	Hornyhead Chub Longnose Dace	Bluegill	Pumpkinseed	Common shiner	
	6	6	3 (5)	10	9 (5)	1" ~ 20 fish	1	3	2	
	4	5		11				3		
	5	6 (5)		10				4		
	4			10						
	6			9 (5)						
	6									
	5									
	4									
	6									
	5									
	5									
	6									
	6 (5)									
Total:	13	3	1	*	*	20	1	3	1	

* = Number totalled on previous species entry • Fish for transport: Samples

Environmental Resources Management, Inc.
23352 128th Avenue
Holland Michigan 49424
616.399.3500
616.399.3777 (fax)

T34 R29W S11,12

ERM

FISH SAMPLING DATA SHEET

Date: 6/23/9

Water body: Menominee River

Location: Stephenson, MI

Sample Station ID AQ2

Bank Sampled (River Only; looking upstream R or L): R and L

Collectors: B. Pabe, Mark Baker, J. Williams

GPS Start (Include datum): (UTM; NAD83) See below

GPS End: (UTM; NAD83) See below

Sampling Start Time: 1330

Sampling End Time: 1810

Gear Type: Boom-shocker, Seine

Gear Comments: TOTAL SHOCK TIME: 3,197 sec. 53.3 minutes

Weather Conditions: Sunny 85°F

Conductivity: (umhos) ____

Secchi reading (ft): ____

Comments/Notes:

Cond. meter Calibration: slope = 1.007 413 standard 140 F @ 23.7°C

- 1st stop @ 1345 (~0.4 mi) @ GPS AQ2 ES stop 1; 711 sec shock time ~550V, 60pps DC, 5-8A 3.5 PW
- 2nd stop @ GPS AQ2 ES stop 2; 653 sec shock ~ 330V, 60pps DC, 5 PW ~ 10 amp
- 3rd stop @ GPS AQ2 ES stop 3 (end of track); 763 sec shock ~ 190V, 120pps DC, ~4 amp (~70%) " ~ 707V, 60pps DC, ~4.7A (~30%)
- @ GPS AQ2 Seine 1 - Seine 1X; 100's of Redhorse fingerlings @ least 2 minnow species: Northern Redbelly Dace & Common Shiner
- 4th stop @ GPS AQ2 STOP 4; 330 sec. shock @ 60pps DC, 707, 884, & 1061V (~1/3 each)
- @ GPS AQ2 STOP 4 - Seine 1X; ~100 Fingerlings - mostly sucker sp. and a few unknowns
- 5th stop @ GPS AQ2 STOP 5; 740 sec 60pps DC 707V ~ 8A

Back @ launch 1810

GPS shock Areas: [UTM, NAD83]:

START 1 = 16T 434970, 5034109	STOP 1 = 16T 434469, 5033540 (~0.4 mi)
START 2 = 16T 434469, 5033540	STOP 2 = 16T 434058, 5033242 (~0.4 mi)
START 3 = 16T 434058, 5032942	STOP 3 = 16T 433717, 5032692 (~0.4 mi)
START 4 = 16T 433781, 5032804	STOP 4 = 16T 434639, 5033439 (~0.7 mi)
START 5 = 16T 434639, 5033439	STOP 5 = 16T 434984, 5034080 (~0.5 mi)

* Note: STOP 1-3 shocked downstream

STOP 4 & 5 shocked upstream

Fish Contaminant Samples (12) Shorthead Redhorse

Waterbody: Menominee River
Date 6/23/09 **Station ID:** AQ2
Gear: Boom-shocker (NO Serve data on this page)
Collectors: B. Lake, M. Barker, J. Williams

Species: (inches)	Shovelnose Redhorse	Silver Redhorse	Golden Redhorse	Golden Redhorse	Hog Sucker	Sturgeon				
	16"	17"	16"	17 (Pic 2)	14" (02)	24" (3)				
	13	19	15	(1) 18	15					
	17	16	20		12 (4)					
	17	18 (1)	21							
(1)	16		19							
	17		15							
	20		22							
	17		15							
	17		(02) 16							
	19		15 (03)							
	17		16							
	• 15		17							
	• 16		15							
	• 16		10							
	• 17		(4) 17							
	• 19		22							
(02)	• 14		21							
	• 15		22							
	• 16		(5th) 20							
	• 17									
(02)	• 17									
	• 20									
	• 17									
(5th)	• 18									
Total:	24	4	21 *	*	3	1				

* Total included with first species listing. • Fish Contaminant Samples

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616.399.3777 (fax)

T 34 N R 21 W S 14/23 & 26

ERM

FISH SAMPLING DATA SHEET

Date: 6/24/09

Water body: Menominee River

Location: Stephenson, MI

Sample Station ID AQ3

Bank Sampled (River Only; looking upstream R or L): R + L

Collectors: B. Fahe, M. Baker, J. Williams

GPS Start (Include datum): See below

GPS End: See below

Sampling Start Time: 1040

Sampling End Time: 1440

Gear Type: Boom Shocker

Gear Comments: TOTAL shock time: * 2,600 seconds
43.3 minutes

Weather Conditions: Sunny 90°F

Conductivity: (umhos) 267 (@ Launch)

Secchi reading (ft): —

* Shock time limited due to inability to shock large rapids & stretch of river.

Comments/Notes:

Conductivity #2: 1.003 ; 1410 @ 27°C (calibration).

1st stop: 865 sec shock time; 3 Pulse width; 60 pps DC 707 volt } shocked Downstream
2nd stop: 211 sec @ GPS 008
3rd stop: @ GPS 009 Same shocker 354 sec.

Seine 1X @ GPS ~~AQ3~~ Seine1; Some redhorse fingerlings 5, 1 ~~E~~ Towardster, E

4th stop @ GPS 011 ; 827 sec ; same settings } shocked upstream

5th stop. — of fish 343 sec ; Same settings

Seine 1X @ GPS AQ3 Seine2 : See WATTS sheets

GPS Shock Areas: [UTM, NAD83]

START 1 = 16T 433340, 5029294
START 2 = 16T 433541, 5028132
START 3 = 16T 433355, 5028030
START 4 = 16T 432877, 5027799
START 5 = 16T 433501, 5028484

STOP 1 = 16T 433478, 5028562 (~0.5 mi)
STOP 2 = 16T 433355, 5028030 (~0.1 mi)
STOP 3 = 16T 432851, 5027711 (~0.4 mi)
STOP 4 = 16T 433446, 5029962 (~0.4 mi)
STOP 5 = 16T 433338, 5029238 (~0.5 mi)

Waterbody: Menominee River

Date 6/24/9 **Station ID:** AQ3

Gear: Boom shocker, Seine

Collectors:

Species:	Carp	Shorthead Redhorse	Golden Redhorse	N Brook lamprey	Stuwaom	Log Perch	Silver redhorse	Seine 2: Smallm Bass	Seine 2: Longnose shiner	Seine 2: Redhorse (species)
	27 (1)	19" (1)	10"	6" (1)	36" (1)	4 (1)	22" (2)	5	~150 young of year	~150 young of year
		19	20 (1)		30"*	4	15 (4)			
		18			40"* (2)	3				
		21			30**	5 (2)				
		18 (2)			45					
		17			45					
		20			45					
		14 (3)			45 (3)					
		14 (4)			60**					
					45**					
					28 (4)					
Total:	1	9	2	1	11	4	2	1	~150 young of year	~150 young of year

* 4" NB lamprey

** Estimated size; Did not boat fish

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: —

STATION NUMBER: AQ4 INVESTIGATOR(S): Bruce Rabe, Jeff Williams, Stan Kenwa DATE: 08/03/08

BODY OF WATER: Shakey River LOCATION: approx. 0.7 mi upstream (North) from Menominee River confluence

COUNTY: Menominee TOWNSHIP: Lake T 35 R 29 S 23 SE 1/4 NW 1/4 GPS: N45.41654 W87.85254 [Downstream start]

STREAM TYPE: ( )Coldwater (X)Warmwater SURVEY TYPE: ( )PS (X)NPS ECOREGION: Western Upper Peninsula

WEATHER: (X)Sunny ( )Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: 82 °F WATER TEMP.: 80.6 °F

AVG . STREAM WIDTH 50 ft. AVG. DEPTH 1 ft. SURFACE VELOCITY 0.42 ft./sec. ESTIMATED FLOW: 21 cfs

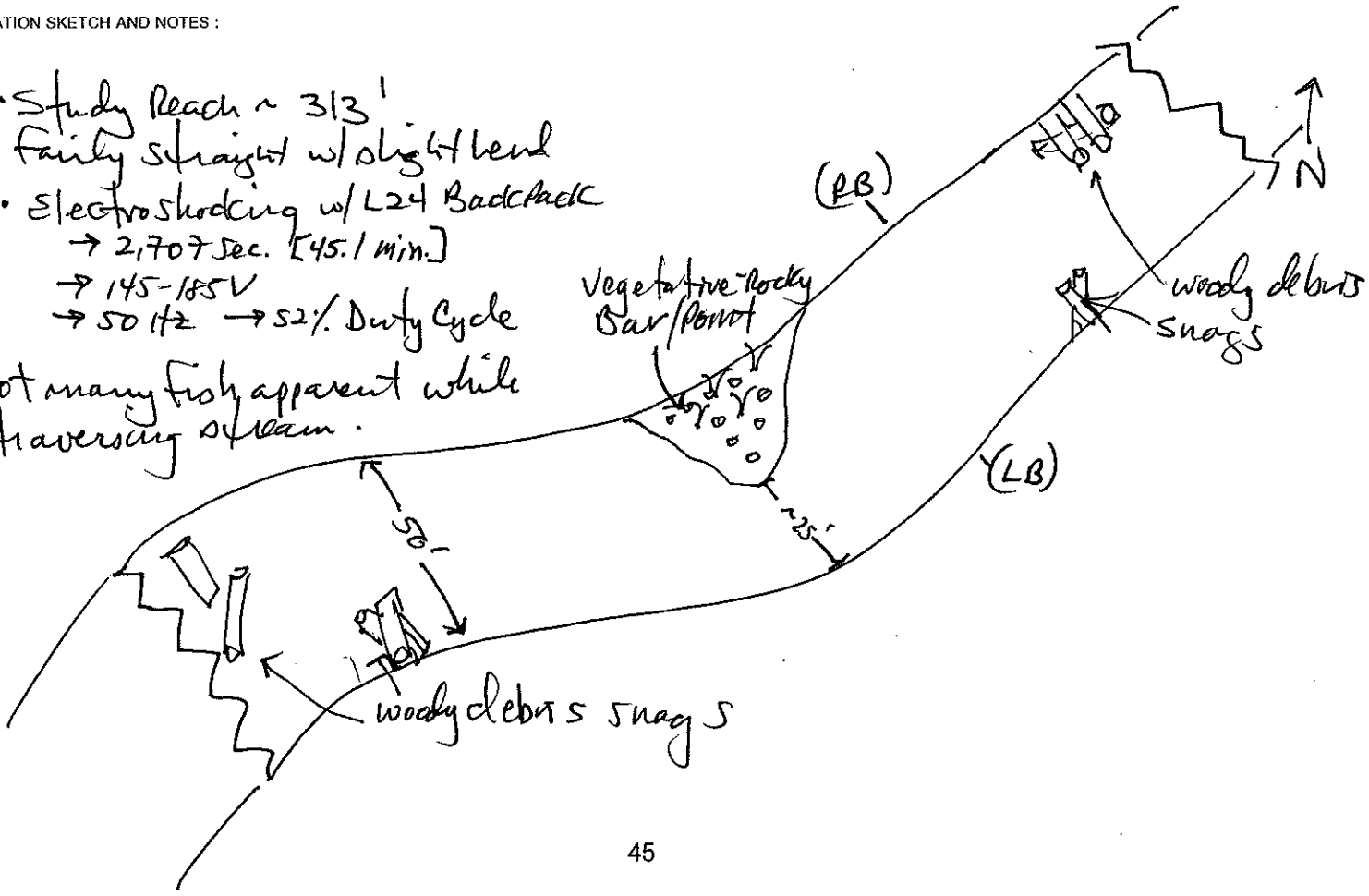
STREAM MODIFICATIONS:
(X) None
( ) Dredged
( ) Canopy Removal
( ) Snagging
( ) Impounded
( ) Relocated
( ) Bank Stabilization
( ) Habitat Improvement

Attached algae and macrophytes: present See periphyton data

Nuisance aquatic plant or slimes conditions present? (N)

STATION SKETCH AND NOTES :

- Study Reach ~ 313'
- Fairly straight w/ slight bend
- Electroshocking w/ L24 Backpack
  - → 2,707 sec. [45.1 min.]
  - → 145-185 V
  - → 50 Hz → 52% Duty Cycle
- Not many fish apparent while traversing stream.



Location Sampled AQ4 Date 8/3/18

Length sampled 3131 Time sampled 2,707 Sec Gear type (circle) bps stream shocker boat shocker other

Species / length (in)	Northern Pike	LM Bass	Bluegill	hornyhead chub	SM Bass	Rock Bass	Blackside Darter	Johnny Darter	In
1								1	1
2		1111						1	2
3		1	1111	111		11	111		3
4			1111	11		1			4
5			1		1	1			5
6	1					1			6
7									7
8		1							8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17	(1)	(7)	(11)	(5)	(1)	(5)	(3)	(2)	17
18									18
19									19
20									20
>20									

For individuals >20" record actual length

Species / length (in)	Tadpole/ mud bum								In
1									1
2									2
3	1								3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16	(1)								16
17									17
18									18
19									19
20									20
>20									

Number of Anomalies /

Number/Species of tagged/fin clipped fish /

Description:

Volt: 145-185V
Frequ. 50 Hz
Duty Cycle 52%

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: —

STATION NUMBER: AQ8 INVESTIGATOR(S): Jeff Williams, Bruce Rabe DATE: 08,05,08

BODY OF WATER: Sitakey Baker LOCATION: AQ8

COUNTY: Monroe TOWNSHIP: Lake T — R — S — GPS: N45 25' 31.7" W83 46' 36.5"

STREAM TYPE: ( )Coldwater (X)Warmwater SURVEY TYPE: ( )PS (X)NPS ECOREGION: Western upper Peninsula

WEATHER: (X)Sunny ( )Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: 85°F WATER TEMP.: 26°C

AVG . STREAM WIDTH 16 ft. AVG. DEPTH 1.25 ft. SURFACE VELOCITY NA ft./sec. ESTIMATED FLOW: — cfs

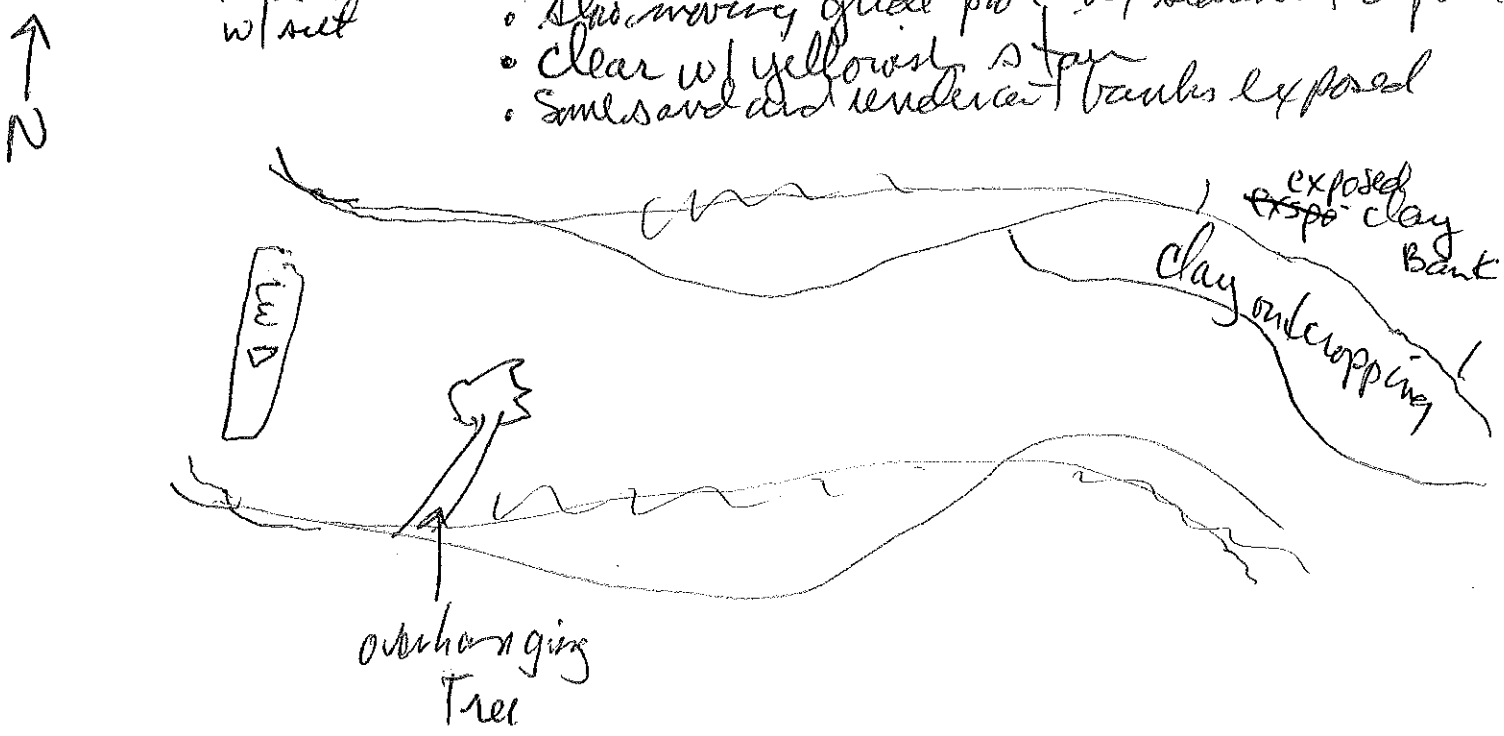
STREAM MODIFICATIONS: (X) None ( ) Impounded
( ) Dredged ( ) Relocated
( ) Canopy Removal ( ) Bank Stabilization
( ) Snagging ( ) Habitat Improvement

Attached algae and macrophytes: See Pamphlyte bio data

Nuisance aquatic plant or slimes conditions present? Y / (N)

STATION SKETCH AND NOTES :

- remaining substrate (sand) covered w/ silt
- 30% bottomed covered w/ vegetation - mostly wild celery
- slow moving glide-pool w/ sediment deposition
- clear w/ yellowish stain
- some sand and undercut banks exposed



Location Sampled AQ8 Date 8/5/18

Length sampled 225' Time sampled 2,096 Sec Gear type (circle): bps stream shocker boat shocker other

Species / length (in)	Bluegill	LM Bass	Rock Bass	Yellow Perch					In
1									1
2		IIII							2
3	HHT III		IIII	II					3
4	HHT HHT		II						4
5	HHT I								5
6	I								6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18	(25)	(4)	(6)	(2)					18
19									19
20									20
>20									

For individuals >20" record actual length

Species / length (in)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Number of Anomalies —

Number/Species of tagged/fin clipped fish —

Description:

Volts: 185V
Freq: 30
DutyCycle: 32%

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: —

STATION NUMBER: AQ9 INVESTIGATOR(S): Bruce Rabe, Jeff Williams, Steve Rewa DATE: 08/02/08

BODY OF WATER: Little Shakey Creek LOCATION: L.S.C. approx. 0.3 miles South of CR 356 & ~0.7mi NE of Duck LK.

COUNTY: Menominee TOWNSHIP: Lake T 35 R 28 S 10 SW 1/4 SE 1/4 GPS: N45. 44460 W87. 74973 (mid-reach)

STREAM TYPE: ( )Coldwater (X)Warmwater SURVEY TYPE: ( )PS (X) NPS ECOREGION: West Upper Peninsula (Lake MI Basin)

WEATHER: (X)Sunny ( )Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: 82 °F WATER TEMP.: 68 °F

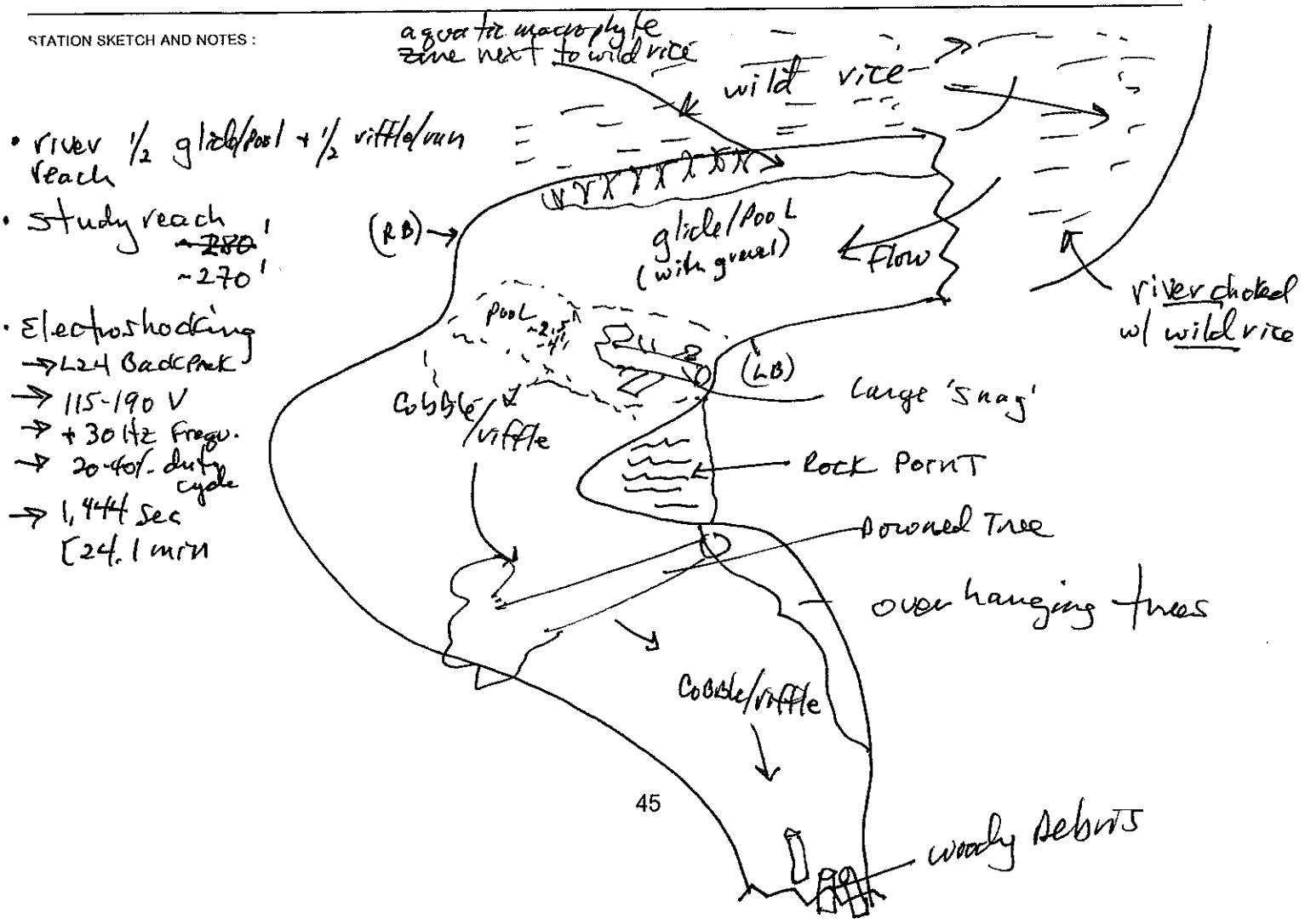
AVG. STREAM WIDTH 20 ft. AVG. DEPTH 1 ft. SURFACE VELOCITY 0.34 ft./sec. ESTIMATED FLOW: 6-8 cfs

STREAM MODIFICATIONS: (X) None ( ) Impounded ( ) Dredged ( ) Relocated ( ) Canopy Removal ( ) Bank Stabilization ( ) Snagging ( ) Habitat Improvement

Attached algae and macrophytes: present

Nuisance aquatic plant or slimes conditions present? Y (N)

STATION SKETCH AND NOTES :



Location Sampled AQ9 Date 8/2/18

Length sampled 260' Time sampled 1,444sec Gear type (circle): bps stream shocker boat shocker other

Species / length (in)	Hornyhead Chub	common shiner	Rock Bass	Northern Pearl Dace	Tadpole Madtom	West. Blacknose Dace	Northern Creek Chub		In
1		1							1
2	𝍸 𝍸 𝍸	𝍸	1	𝍸	1	𝍸	1		2
3	𝍸 𝍸 𝍸 1	𝍸	𝍸	11		111			3
4	𝍸 11		111						4
5			1						5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18	(38)	(11)	(10)	(5)	(1)	(7)	(1)		18
19									19
20									20
>20									

For individuals >20" record actual length

Species / length (in)	Central mudminnow	Fantail Darter							In
1									1
2	𝍸 1	𝍸							2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17	(9)	(5)							17
18									18
19									19
20									20
>20									

Number of Anomalies 0 Number/Species of tagged/fin clipped fish 0

Description:

Volt.: 115-190V

Freq: 30

Duty Cycle 20-40%

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: —

STATION NUMBER: AQ10 INVESTIGATOR(S): Jeff Williams, Bruce Rabe, Steve Rewa DATE: 08/01/08

BODY OF WATER: Shakey River LOCATION: Between Broeberg rd (to South) and CR 356 (to North)

COUNTY: Menominee TOWNSHIP: LAKE T 35 R 28 S 4 NE1/4 SW1/4 GPS: N45.45589 W87.77274

STREAM TYPE: X Coldwater ( )Warmwater SURVEY TYPE: ( )PS X NPS ECOREGION: Western U.P. (Lake MI Basin)

WEATHER: X Sunny X Partly Cloudy ( )Cloudy X Rainy AIR TEMP.: 82°F WATER TEMP.: 66.2°F

AVG . STREAM WIDTH 23 ft. AVG. DEPTH 1.5 ft. SURFACE VELOCITY 0.35 ft./sec. ESTIMATED FLOW: 12.1 cfs

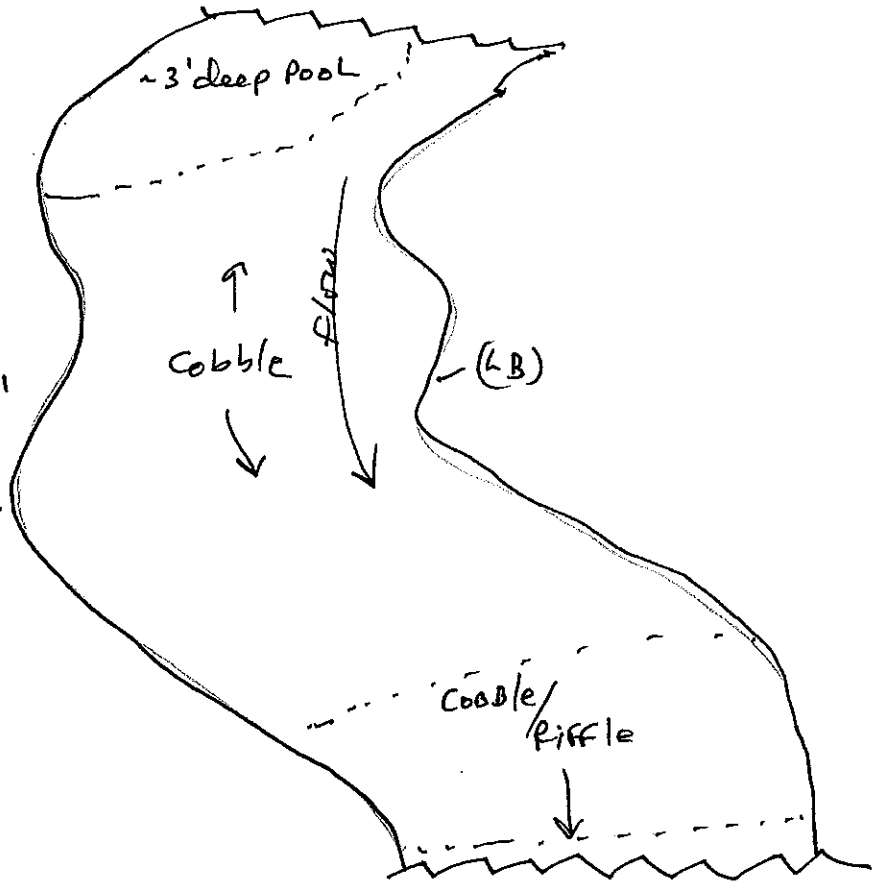
STREAM MODIFICATIONS: X None ( ) Impounded ( ) Dredged ( ) Relocated ( ) Canopy Removal ( ) Bank Stabilization ( ) Snagging ( ) Habitat Improvement

Attached algae and macrophytes: present See floristic data

Nuisance aquatic plant or slimes conditions present? Y (N)

STATION SKETCH AND NOTES :

- ~90% stream cobble
- clear w/ brown/yellowish stain
- entirely riffle/run
- minimal embeddedness
- Fish survey length ~260'



- L24 Back Pack Shocker
  - → 160 + 230 VOLT
    30 + 60 Hz
    20 Duty Cycle
  - → 2,314 Sec. Shocking time (38.6 minutes)

Location Sampled AQ10 Date 8/1/18

Length sampled 268' Time sampled 2,314 Sec Gear type (circle) bps stream shocker boat shocker other

Species / length (in)	Common Shiner	Pearl Dace	West Blacknose Dace	Rock Bass	Brook Trout	horny-head chub	North. Creek Lamprey	green Sunfish	In
1									1
2	𝍸 𝍸	𝍸 𝍸	𝍸 𝍸 ||||		|				2
3	𝍸 |||	𝍸 𝍸 ||	𝍸 𝍸 |	||	|	𝍸 ||||	|		3
4	𝍸 ||	𝍸 ||	|||	|||		𝍸 ||	|||	|	4
5		𝍸				||			5
6		|							6
7					|				7
8									8
9					|				9
10					||				10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18	(25)	(35)	(28)	(5)	(3)	(18)	(4)	(1)	18
19									19
20									20
>20									

For individuals >20" record actual length

Species / length (in)	white Sucker	fantail darter	Northern Creek chub	tadpole madtom	Johnny darter				In
1									1
2		||	|						2
3			|	|	|				3
4									4
5									5
6									6
7									7
8									8
9									9
10	|								10
11									11
12	|								12
13									13
14									14
15									15
16									16
17									17
18	(2)	(2)	(2)	(1)	(1)				18
19									19
20									20
>20									

Number of Anomalies 0 Number/Species of tagged/fin clipped fish 0

Description:

VOLT: 160 V
Freq: 30 Hz & 60 Hz
Duty Cycle: 20

water Chemistry:
Temp° C = 21.3
pH (S.U.) = 8.8
D.O. mg/L = 12.2
Conduct. µS/cm = 383

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: ~~5~~

STATION NUMBER: AQ4 INVESTIGATOR(S): M. Baker, J. Williams, F. Gardner DATE: 7, 17, 09

BODY OF WATER: Shakey River LOCATION: near Confluence w/ Menominee River

COUNTY: Menominee TOWNSHIP: Lake T 35 R 29 S 23 SE/4 NW/4 GPS: 16T 433271 5029611 [UTM, NAD 83] (Beam Stream Start)

STREAM TYPE: ( )Coldwater (✓)Warmwater ~~SURVEY TYPE: ( )PS ( ) NPS~~ ECOREGION: Western Upper Peninsula [Lake Michigan Basin]

WEATHER: ( )Sunny ( )Partly Cloudy (✓)Cloudy ( )Rainy AIR TEMP.: 18.3°C [65°F] WATER TEMP.: 21.3°C [70.3°F]

AVG. STREAM WIDTH ~44 ft. AVG. DEPTH ~10" ft. SURFACE VELOCITY 1.4 ft./sec. [22.5 miles/day] ESTIMATED FLOW: ~~—~~ cfs

STREAM MODIFICATIONS: ~~(✓)~~ None ( ) Dredged ( ) Canopy Removal ( ) Snagging ( ) Impounded ( ) Relocated ( ) Bank Stabilization ( ) Habitat Improvement

Attached algae and macrophytes: ~~—~~

Nuisance aquatic plant or slimes conditions present? Y (N)

STATION SKETCH AND NOTES:

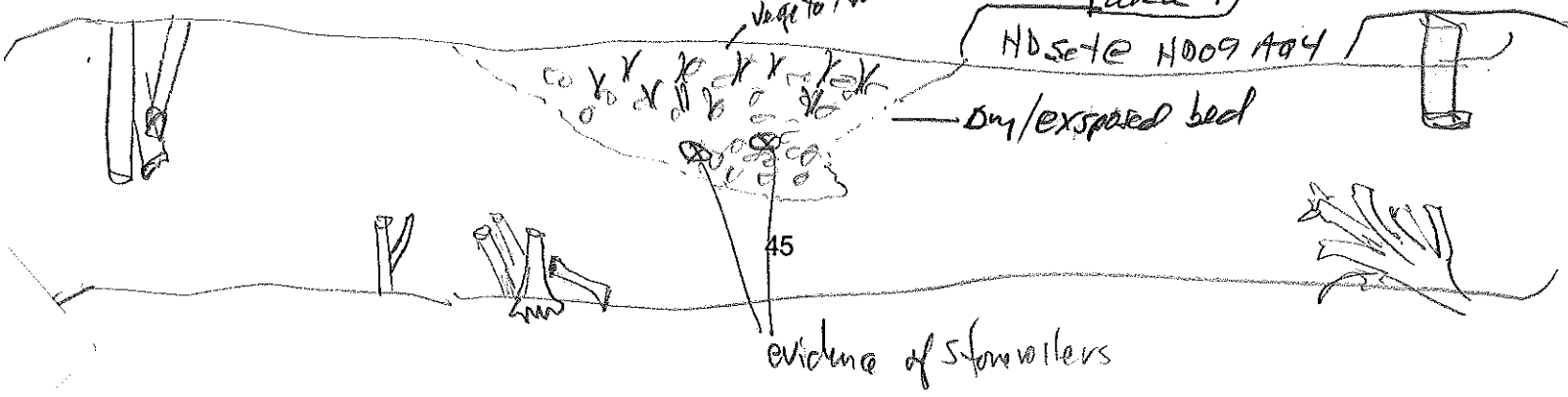
-Standard pulse 1000-1130 eshocking
— 20% Duty Cycle — 200 V; 30 Hz
Time shocked = 1673 seconds

Comments
* stream appears very flashy
* very similar appearance to 2008 assessment
* 90% of substrate covered w/ Aquatic vegetation; Mostly aquatic veg. Habitat
* significant woody debris

Overstory: Basswood, Green Ash, Swamp white oak, Silver maple, Black Ash
Shrub: prickly Ash (not much shrub near riverbank, mostly overstory)
Herbaceous: Royal Fern, Joe-pie weed, Rice-cut grass, False nettle, stinging nettle, Jack-in-pulpit, swamp loosestrife, wild-mint (Canada), wild bergamot, swamp milkweed, Common wateR Hemlock, Carex sp., prickly Ash, Carex ~~hitchcockiana~~ (~~pseudocyperus~~ Sedge), sensitive fern, Cinnamon fern, swamp dewberry, Iris virginica, violet sp., green briar, bed straw, ~~turtle head~~ false dragonhead
Aquatic: wild celery, potamogeton foliosus, potamogeton sp. (thin leafed), Najas flexilis, Chara sp. [90% of Aquatic veg. covered w/ macro-algae]
Substrate: mainly gravel & cobble covered w/ sand, minimal sediment

MACRO-INVERT. Composite: 175 organisms

Observed one (1) River otter swimming just downstream of study area.



Location Sampled A04 Date 7/17/9

ength sampled 313' Time sampled 1,673sec Gear type (circle) bps stream shocker boat shocker other

pecies length (in)	Hornyhead Chub	White Sucker	Smallmouth Bass	Rock Bass	Crayfish	Bluegill	Common Shiner	Blackside Darter	In
1	11	++++ |||	1		|||		1		1
2	++++ ++++ ++++ ++++	++++ ||||		11		1	1	++++	2
3	++++ |||			1		|||	1	|||	3
4			1	1					4
5				1	1				5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18						(4)	(3)	(8)	18
19									19
20	(50)	(20)	(2)	(5)	(4)				20
>20									

For individuals >20" record actual length

ecies length (in)	Yellow Perch	Brown Bullhead	Logperch	Black Bullhead	Hornyhead Chub	Largemouth Bass			In
1	1	1	|||						1
2		++++ 1	1	1	++++ ||| *				2
3									3
4		||		1		1			4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18	(1)	(9)	(4)	(1)	(*)	(1)			18
19									19
20									20
>20									

Number of Anomalies 0 Number/Species of tagged/fin clipped fish —

Description:

* Totaled above

Species length)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

For individuals >20" record actual length

Species length `)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Additional station comments:

Appendix J (continued)

FISH

Station Number: A04
Length Sampled (ft): 312'
Area Sampled (sq ft): —
Sampling Time: 1,673 sec. (27.9 minutes) # Probes: 1 # Passes: 1
Gear: boat / ss (bps)
Number of Anomalies: 0
Comments:

Petromyzontidae (Lampreys)		Sand shiner		**Gasterosteidae (Sticklebacks)**	
Sea lamprey (a/l)		Redfin shiner		Brook stickleback	
Silver lamprey (a/l)		Mimic shiner		Threespine stickleback	
Northern brook lamprey (a/l)		Brassy minnow		**Perchicthyidae (Temp. bass)**	
Chestnut lamprey (a/l)		Fathead minnow		*White bass	
American brook lamprey (a/l)		Bluntnose minnow		*White perch	
Lepisosteidae (Gars)		Suckermouth minnow		**Centrarchidae (Sunfishes)**	
*Spotted gar		Silverjaw minnow		*Rock bass	5
*Longnose gar		Northern redbelly dace		*Green sunfish	
Amiidae (Bowfins)		Southern redbelly dace		*Pumpkinseed	
*Bowfin		Finescale dace		*Warmouth	
Clupeidae (Herrings)		Blacknose dace		*Orangespotted sunfish	
*Alewife		Longnose dace		*Bluegill	4
*Gizzard shad		Redside dace		*Longear sunfish	
Salmonidae (Salmon/Trout)		*Pearl dace		*White crappie	
*Rainbow trout		**Cottidae (Sculpins)**		*Black crappie	
*Brown trout		Mottled sculpin		*Largemouth bass	1
*Brook trout		Slimy sculpin		*Smallmouth bass	2
*Coho		**Catostomidae (Suckers)**		**Percidae (Perch)**	
*Chinook		*Longnose sucker		N. sand darter	
Umbridae (Mudminnow)		*White sucker	20	Rainbow darter	
Central mudminnow		*Creek chubsucker		Iowa darter	
Esocidae (Pike)		*Lake chubsucker		Greenside darter	
*Grass pike		*Northern hog sucker		Fantail darter	
*Northern pike		*Spotted sucker		Orangethroat darter	
*Muskellunge		*Silver redhorse		Johnny darter	
Cyprinidae (Minnows and Carp)		*River redhorse		Blackside darter	8
Central stoneroller		*Black redhorse		Logperch	4
Lake chub		*Golden redhorse		*Yellow perch	1
*Goldfish		*Shorthead redhorse		*Walleye	
*Carp		*Greater redhorse		**Percopsidae (Trout-perch)**	
Bigeye chub		**Ictaluridae (Bullhead/Catfish)**		Trout-perch	
*Hornyhead chub	50	*Black bullhead	1	**Anguillidae (Eels)**	
*River chub		*Brown bullhead	9	*American eel	
*Creek chub		*Yellow bullhead		**Gadidae (Cod)**	
*Golden shiner		Stonecat		*Burbot	
Pugnose shiner		Tadpole madtom		**Sciaenidae (Drums)**	
Emerald shiner		Brindled madtom		*Freshwater drum	
Bigeye shiner		*Channel catfish		**Cobitidae (Loaches)**	
Ironcolor shiner		*Flathead catfish		Oriental weatherfish	
*Common shiner	3	**Aphredoderidae (Pirate perch)**		**Other family/species:**	
Central bigmouth shiner		Pirate perch		_____	
Blackchin shiner		**Atherinidae (Silversides)**		_____	
Blacknose shiner		Brook silverside		_____	
Spottail shiner		**Cyprinodontidae (Topminnows)**		_____	
Silver shiner		Banded killifish			
Rosyface shiner		Blackstripe topminnow			
Spotfin shiner				* = Measured length	

Water Chemistry:
Temp°C: 25.6
pH (S.U.) = 8.5
D.O. mg/L = 9.9
Conductivity (uS/cm) = 432

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: ——

STATION NUMBER: AQ8 INVESTIGATOR(S): J. Williams, M. Baker, F. Gardner DATE: 07 / 15 / 09

BODY OF WATER: Shakey River LOCATION: Near Johnson Lake

COUNTY: Menominee TOWNSHIP: Lake T 34 R 28 S 16 GPS: 16T 439213 5030519 [UTM, NAD83] Downstream start

STREAM TYPE: ( )Coldwater (X)Warmwater ~~SURVEY TYPE: ( )PS (✓)NPS~~ ECOREGION: Western Upper Peninsula [Lake Michigan Basin]

WEATHER: ( )Sunny (X)Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: ~23.9°C [~75°F] WATER TEMP.: 25.6°C [78.1°F]

AVG. STREAM WIDTH 23 ft. AVG. DEPTH 18" ~~ft.~~ SURFACE VELOCITY 0.264 ft./sec. [10.5 miles/day] ESTIMATED FLOW: ______ cfs

STREAM MODIFICATIONS: (✓)None ( )Impounded ( )Dredged ( )Relocated ( )Canopy Removal ( )Bank Stabilization ( )Snagging ( )Habitat Improvement

Attached algae and macrophytes: ——

Nuisance aquatic plant or slimes conditions present? Y/(N)

STATION SKETCH AND NOTES: [~1230 – 1730] MACROINVERT COLLECTION: 190 org.

e-shocking: Frequ = 30 Hz, Duty cycle = 20%, Volts = 200, standard pulse
Time shocked = 1428 seconds; Same parameters as AQ9 + AQ10

* stream filled/dominated by Vallisneria americana, some arrowarum; Najas

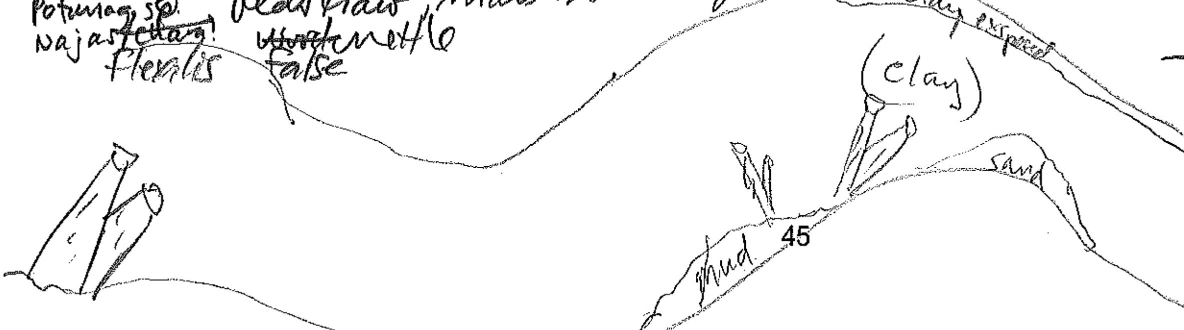
Vegetation:
overstory: green ash, black ash, swamp white oak
shrub: Nanny Berry (Viburnum lentago), speckled alder
Herbaceous: Sensitive fern, rice cut grass, Carex sp.
swamp milkweed, greenbriar, Hog peanut
Iris virginica, Carex lurida, bladder sedge
woolgrass, lower half DS side on LB = Reed canary grass
Carex gracillima, turtlehead, joe-pye weed
smooth goldenrod, violet sp., dogbane
bedstraw, marsh shield fern, swamp loosestrife
false nettle

Aquatic:
wild celery
Potamogeton sp.
Najas flexilis

SET HDC (HD09 AQ8) (GPS005) @ 1600

Stream substrate: Clay + sand

Glide-Pool; no Riffles



Location Sampled 408 Date 7/15/9

Length sampled 340' Time sampled 1428 sec Gear type (circle): bps stream shocker boat shocker other

Species / length (in)	Rock Bass	Bluegill	Brown Bullhead	Yellow Perch	Central Mudminnow	Northern Pike	Johnny Darter		In
1									1
2	IIII				II		I		2
3	II	II	I	III					3
4	I	IIII II							4
5	I	IIII II				I			5
6									6
7	II								7
8	I								8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20	(12)	(16)	(1)	(3)	(2)	(1)	(1)		

For individuals >20" record actual length

Species / length (in)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Number of Anomalies 0 Number/Species of tagged/fin clipped fish 0

Description:

Species length)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

For individuals >20", record actual length

Species length ")									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Additional station comments:

Appendix J (continued)

FISH

Station Number: A08
Length Sampled (ft): 240
Area Sampled (sq ft): —
Sampling Time: 1428 Sec. (23.8 minutes) # Probes: 1 # Passes: 1
Gear: boat / ss / bps
Number of Anomalies: 0
Comments: —

Petromyzontidae (Lampreys)		Sand shiner		**Gasterosteidae (Sticklebacks)**	
Sea lamprey (a/l)		Redfin shiner		Brook stickleback	
Silver lamprey (a/l)		Mimic shiner		Threespine stickleback	
Northern brook lamprey (a/l)		Brassy minnow		**Perchicthyidae (Temp. bass)**	
Chestnut lamprey (a/l)		Fathead minnow		*White bass	
American brook lamprey (a/l)		Bluntnose minnow		*White perch	
Lepisosteidae (Gars)		Suckermouth minnow		**Centrarchidae (Sunfishes)**	
*Spotted gar		Silverjaw minnow		*Rock bass	12
*Longnose gar		Northern redbelly dace		*Green sunfish	
Amiidae (Bowfins)		Southern redbelly dace		*Pumpkinseed	
*Bowfin		Finescale dace		*Warmouth	
Clupeidae (Herrings)		Blacknose dace		*Orangespotted sunfish	
*Alewife		Longnose dace		*Bluegill	16
*Gizzard shad		Redside dace		*Longear sunfish	
Salmonidae (Salmon/Trout)		*Pearl dace		*White crappie	
*Rainbow trout		**Cottidae (Sculpins)**		*Black crappie	
*Brown trout		Mottled sculpin		*Largemouth bass	
*Brook trout		Slimy sculpin		*Smallmouth bass	
*Coho		**Catostomidae (Suckers)**		**Percidae (Perch)**	
*Chinook		*Longnose sucker		N. sand darter	
Umbridae (Mudminnow)		*White sucker		Rainbow darter	
Central mudminnow	2	*Creek chubsucker		Iowa darter	
Esocidae (Pike)		*Lake chubsucker		Greenside darter	
*Grass pike		*Northern hog sucker		Fantail darter	
*Northern pike	1	*Spotted sucker		Orangethroat darter	
*Muskellunge		*Silver redhorse		Johnny darter	1
Cyprinidae (Minnows and Carp)		*River redhorse		Blackside darter	
Central stoneroller		*Black redhorse		Logperch	
Lake chub		*Golden redhorse		*Yellow perch	3
*Goldfish		*Shorthead redhorse		*Walleye	
*Carp		*Greater redhorse		**Percopsidae (Trout-perch)**	
Bigeye chub		**Ictaluridae (Bullhead/Catfish)**		Trout-perch	
*Horneyhead chub		*Black bullhead		**Anguillidae (Eels)**	
*River chub		*Brown bullhead	1	*American eel	
*Creek chub		*Yellow bullhead		**Gadidae (Cod)**	
*Golden shiner		Stonecat		*Burbot	
Pugnose shiner		Tadpole madtom		**Sciaenidae (Drums)**	
Emerald shiner		Brindled madtom		*Freshwater drum	
Bigeye shiner		*Channel catfish		**Cobitidae (Loaches)**	
Ironcolor shiner		*Flathead catfish		Oriental weatherfish	
*Common shiner		**Aphredoderidae (Pirate perch)**		**Other family/species:**	
Central bigmouth shiner		Pirate perch		_____	
Blackchin shiner		**Atherinidae (Silversides)**		_____	
Blacknose shiner		Brook silverside		_____	
Spottail shiner		**Cyprinodontidae (Topminnows)**		_____	
Silver shiner		Banded killifish			
Rosyface shiner		Blackstripe topminnow			
Spotfin shiner				* = Measured length	

Water Chemistry: See below

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: ~~—~~

STATION NUMBER: AQ09 INVESTIGATOR(S): J. Williams, M. Baker, F. Gaudner DATE: 7/14/09

BODY OF WATER: Little Shakey Creek LOCATION: Stephenson, MI

COUNTY: Menominee TOWNSHIP: Lake T 34 R 28 S 10 GPS: 16T 441391 5032582 (UTM, NAD83) Down stream start

STREAM TYPE: ( )Coldwater (X)Warmwater SURVEY TYPE: ~~( )PS ( )NPS~~ ECOREGION: Western Upper Peninsula [Lake Michigan Basin]

WEATHER: ( )Sunny (X)Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: ~24°C [~75°F] WATER TEMP.: 19.8°C [67.6°F]

AVG. STREAM WIDTH 30 ft. AVG. DEPTH 12" ft. SURFACE VELOCITY Riffle/Run = 1.13, Glide/Pool = 0.76 ft./sec. [GP = 12.5 miles/hour, R/R = 8.5 "] ESTIMATED FLOW: _____ cfs

STREAM MODIFICATIONS: (X) None ( ) Dredged ( ) Canopy Removal ( ) Snagging ( ) Impounded ( ) Relocated ( ) Bank Stabilization ( ) Habitat Improvement

Attached algae and macrophytes: ~~—~~

Nuisance aquatic plant or slimes conditions present? Y (N)

STATION SKETCH AND NOTES :

- sampled 1700 - 2000
- Standard pulse
- 20% Duty cycle - 200 volts
- 1523 seconds - 30Hz

* Most fish came from DS 1/2 of stream

* Habitat & Macro + Periphyton performed 7/15/09 start @ 0830

Evidence of stoneflies in dry gravel bars

D.O = 6.0 mg/L
T = 19.6 °C
pH = 7.8
Cond = 409 µs/cm
Turb = ~10

observed one (1) wood Duck

Macro Invert = 160 org.

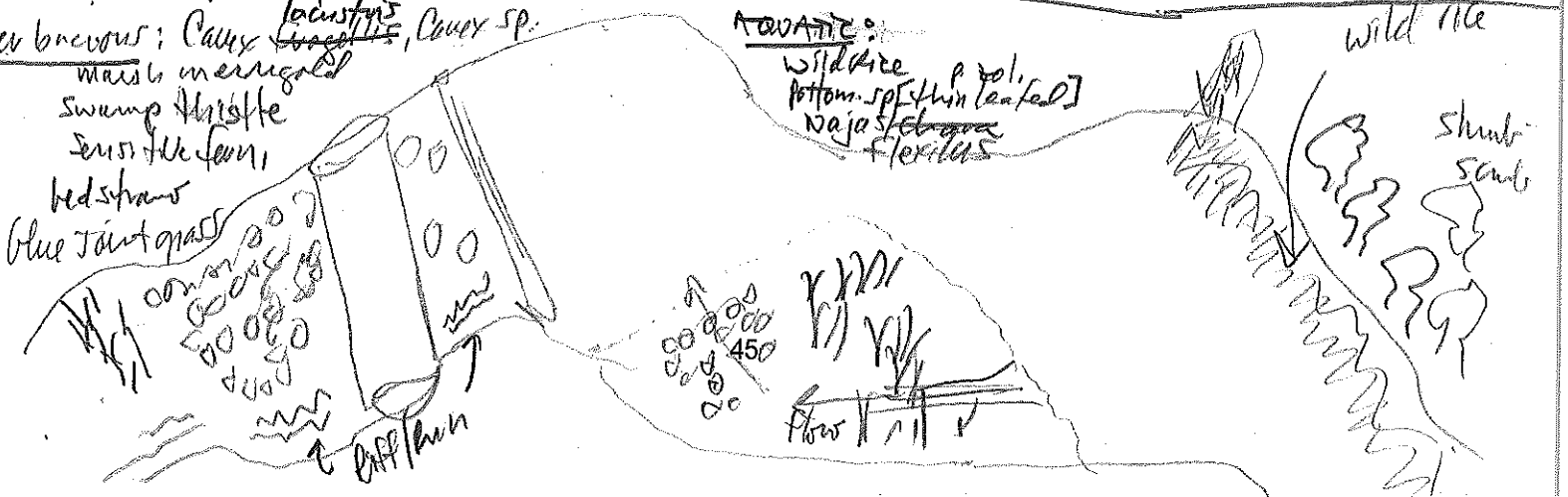
@ HD09 AQ09

SET HOC same GPS as 2008 1100

Vegetation - both banks:

Overstory: (Riffle/Run): Cedar [Cedar-swamp]
Shrub: (R/R): few Nannyberry (Viburnum lentago)
Herbaceous: (R/R): Red osier dogwood, Blackberry, Turtlehead, Bedstraw, Carex sp., Marsh cinquefoil, Rice cut grass, [Marsh, Boreal]
Overstory: (Glide/Pool): Balsam fir, Black spruce, Cedar
Shrub: Sp. Alder, Willow sp. (in marsh), (Sweet gale, Shrubby St. John's wort)
Herbaceous: Carex lacustris, Carex sp., Marsh marigold, Swamp thistle, Sensitive fern, Bedstraw, Blue joint grass

Aquatic: Wild rice, Pond. Pot. sp. [Thin leaved], Naja flexilis



Location Sampled AQ9 Date 7/14/9

Length sampled 300' Time sampled 1,523 Sec Gear type (circle): bps stream shocker boat shocker other

Species / length (in)	Western Blacknose Dace	Horny head Chub	Bluegill	Rock-Bass	Common Shiner	Northern Pike	Crayfish sp.	spottail Shiner	In
1		𝍸 II		I	III				1
2	𝍸 III	𝍸 𝍸 𝍸 𝍸 I	I	II	𝍸 𝍸		II	I	2
3	I	𝍸 𝍸 II	I	II	𝍸 II		I		3
4		III		I					4
5				II		I			5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20	(9)	(62)	(2)	(8)	(32)*	(1)		(1)	

For individuals >20" record actual length

Species / length (in)	Central Mudminnow	Common Shiner	Horny head Chub	Fantail Darter	Fathead minnow	Iowa Darter	Creek Chub		In
1	𝍸			𝍸 𝍸		II			1
2	𝍸 𝍸 𝍸 I	𝍸 *	𝍸	IIII	I				2
3									3
4							I		4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20	(21)	(*)	(*)	(19)	(1)	(2)	(1)		

Number of Anomalies 0 Number/Species of tagged/fin clipped fish 0

Description:

* = totals above

Species									
length)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

For individuals >20" record actual length

Species									
length ")									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Additional station comments:

FISH

Station Number: A09
Length Sampled (ft): 300'
Area Sampled (sq ft): —
Sampling Time: 1,523 Sec. (25.4 min.) # Probes: 1 # Passes: 1
Gear: boat / ss (bps)
Number of Anomalies: 0
Comments: —

Petromyzontidae (Lampreys)
- Sea lamprey (a/l) ____
- Silver lamprey (a/l) ____
- Northern brook lamprey (a/l) ____
- Chestnut lamprey (a/l) ____
- American brook lamprey (a/l) ____

Lepisosteidae (Gars)
- *Spotted gar ____
- *Longnose gar ____

Amiidae (Bowfins)
- *Bowfin ____

Clupeidae (Herrings)
- *Alewife ____
- *Gizzard shad ____

Salmonidae (Salmon/Trout)
- *Rainbow trout ____
- *Brown trout ____
- *Brook trout ____
- *Coho ____
- *Chinook ____

Umbridae (Mudminnow)
- Central mudminnow 21

Esocidae (Pike)
- *Grass pike ____
- *Northern pike 1
- *Muskellunge ____

Cyprinidae (Minnows and Carp)
- Central stoneroller ____
- Lake chub ____
- *Goldfish ____
- *Carp ____
- Bigeye chub ____
- *Horneyhead chub 62
- *River chub ____
- *Creek chub 1
- *Golden shiner ____
- Pugnose shiner ____
- Emerald shiner ____
- Bigeye shiner ____
- Ironcolor shiner ____
- *Common shiner 30
- Central bigmouth shiner ____
- Blackchin shiner ____
- Blacknose shiner ____
- Spottail shiner 1
- Silver shiner ____
- Rosyface shiner ____
- Spotfin shiner ____
- Sand shiner ____
- Redfin shiner ____
- Mimic shiner ____
- Brassy minnow ____
- Fathead minnow 1
- Bluntnose minnow ____
- Suckermouth minnow ____
- Silverjaw minnow ____
- Northern redbelly dace ____
- Southern redbelly dace ____
- Finescale dace ____
- Blacknose dace 9
- Longnose dace ____
- Redside dace ____
- *Pearl dace ____

Cottidae (Sculpins)
- Mottled sculpin ____
- Slimy sculpin ____

Catostomidae (Suckers)
- *Longnose sucker ____
- *White sucker ____
- *Creek chubsucker ____
- *Lake chubsucker ____
- *Northern hog sucker ____
- *Spotted sucker ____
- *Silver redhorse ____
- *River redhorse ____
- *Black redhorse ____
- *Golden redhorse ____
- *Shorthead redhorse ____
- *Greater redhorse ____

Ictaluridae (Bullhead/Catfish)
- *Black bullhead ____
- *Brown bullhead ____
- *Yellow bullhead ____
- Stonecat ____
- Tadpole madtom ____
- Brindled madtom ____
- *Channel catfish ____
- *Flathead catfish ____

Aphredoderidae (Pirate perch)
- Pirate perch ____

Atherinidae (Silversides)
- Brook silverside ____

Cyprinodontidae (Topminnows)
- Banded killifish ____
- Blackstripe topminnow ____

Gasterosteidae (Sticklebacks)
- Brook stickleback ____
- Threespine stickleback ____

Perchichthyidae (Temp. bass)
- *White bass ____
- *White perch ____

Centrarchidae (Sunfishes)
- *Rock bass 8
- *Green sunfish ____
- *Pumpkinseed ____
- *Warmouth ____
- *Orangespotted sunfish ____
- *Bluegill 2
- *Longear sunfish ____
- *White crappie ____
- *Black crappie ____
- *Largemouth bass ____
- *Smallmouth bass ____

Percidae (Perch)
- N. sand darter ____
- Rainbow darter ____
- Iowa darter 2
- Greenside darter ____
- Fantail darter 19
- Orangethroat darter ____
- Johnny darter ____
- Blackside darter ____
- Logperch ____
- *Yellow perch ____
- *Walleye ____

Percopsidae (Trout-perch)
- Trout-perch ____

Anguillidae (Eels)
- *American eel ____

Gadidae (Cod)
- *Burbot ____

Sciaenidae (Drums)
- *Freshwater drum ____

Cobitidae (Loaches)
- Oriental weatherfish ____

Other family/species:
- _____ ____
- _____ ____
- _____ ____
- _____ ____

* = Measured length

water Chemistry: See below

Appendix J

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION

STREAM SURVEY CARD

STORET NO.: _____

STATION NUMBER: AQ10 INVESTIGATOR(S): M. Baker, J. Williams, F. Gardner DATE: 07/14/09

BODY OF WATER: Shakey River LOCATION: B/w 356 and Bobcat Rd.

COUNTY: Menominee Co. TOWNSHIP: Lake T 35 R 28 S 4 GPS: _____

STREAM TYPE: (X) Coldwater ( )Warmwater ~~SURVEY TYPE: ( )PS ( )NPS~~ ECOREGION: Western Upper Peninsula [Lake Michigan Basin]

WEATHER: ( )Sunny (X)Partly Cloudy ( )Cloudy ( )Rainy AIR TEMP.: 23.9°C [75°F] WATER TEMP.: 18.2°C [64.8°F]

AVG. STREAM WIDTH 23 ft. AVG. DEPTH 8" ft. SURFACE VELOCITY 1.1 ft./sec. [18 miles/hour] ESTIMATED FLOW: _____ cfs

STREAM MODIFICATIONS: ( ) None ( ) Impounded ( ) Dredged ( ) Relocated ( ) Canopy Removal ( ) Bank Stabilization ( ) Snagging ( ) Habitat Improvement

Attached algae and macrophytes: —

Nuisance aquatic plant or slimes conditions present? Y / (N)

STATION SKETCH AND NOTES: 1581 sec. shocked - 30Hz - 20% duty cycle - 200 Volts

0930 - 1330 CST E-shocking - standard pulse

- 4-wheeler X-ing @ DS end/line, used recently
- several damselfly adults
- Pair of wood ducks

Surrounding River:

overstory: cedar, blackash, Balsam fir, Red maple, Green ash, ~~Balsam F~~

shrub: ~~Speckled Alder~~ ~~River Bank Birch~~, Balsam Fir, Nanny berry (Viburnum lentago)

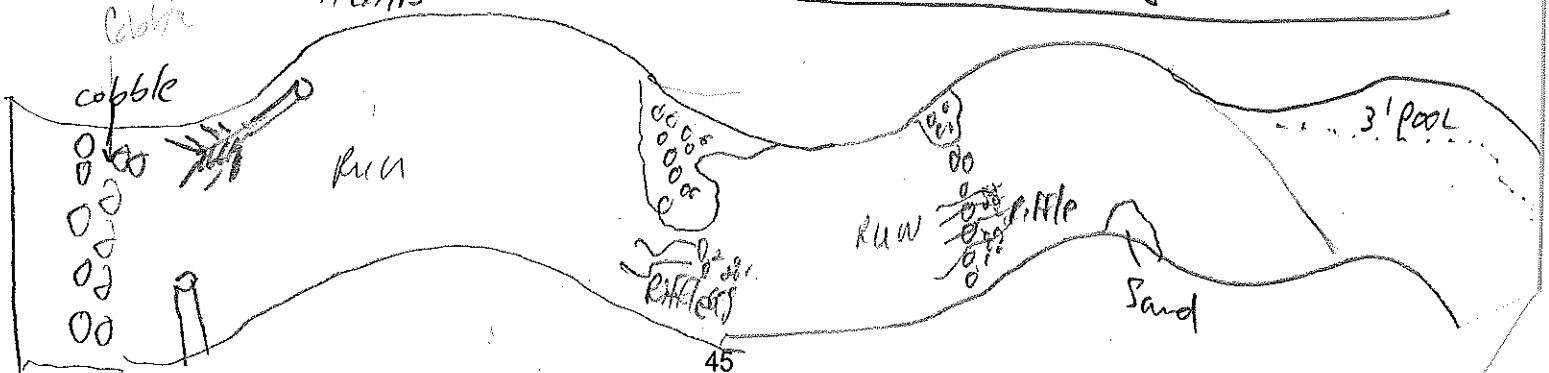
Herbaceous: Cinnamon fern, swamp milkweed, Hog peanut, Sensitive fern, Cinnamon fern, a few spots of Reed Canary grass, Joe-Pie weed, Some Rice-cut grass, Bluejoint grass

Aquatic: Najas flexilis

- MD Set @ GPS NAD09/AQ10 @ 1450 CST

D.O. = 10.4 mg/L
T = 18.2°C
pH = 8.0 s.u.
Cond = 250 mS
Inv = 5

MACROINV = 150 avg.



Location Sampled AQ10 Date 7/14/09

Length sampled 260' Time sampled 1,58/Sec Gear type (circle): bps stream shocker boat shocker other

Species / length (in)	Brook Trout	Creek Chub	Common Shiner	Blacknose minnow	Horny Head Chub	Western Blacknose Dace	Rock Bass	Northern Brook Lamprey	In
1			III	IIIIIII	II	IIII I	I		1
2		II	IIII III	IIII I	IIII IIII IIII	IIII IIII IIII		I	2
3		IIII IIII	IIII II		IIII IIII	IIII	II	I	3
4		IIII IIII I	III		IIII III		I	II	4
5	IIII	IIII I						II	5
6		III							6
7	I								7
8	I								8
9	I								9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20	(8)		(23)	(15)	(40)	35	(4)	(7)	
	(45)	(32)							

For individuals >20" record actual length

Species / length (in)	Crawfish sp.	Fantail Darter	Western Blacknose Dace						In
1	I	IIII IIII							1
2	IIII	IIII	IIII (*)						2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									
	(5)	(15)							

Number of Anomalies 0 Number/Species of tagged/fin clipped fish 0

Description:

(*) Added to total in column above

Species length)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

For individuals >20" record actual length

Species length า)									In
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20
>20									

Additional station comments:

FISH

Station Number: AQ10
Length Sampled (ft): 260
Area Sampled (sq ft): —
Sampling Time: 1,58/Sec. (26.4 min.) # Probes: 1 # Passes: 1
Gear: boat / ss (bps)
Number of Anomalies: 0
Comments: —

Petromyzontidae (Lampreys)		Sand shiner		**Gasterosteidae (Sticklebacks)**	
Sea lamprey (a/l)		Redfin shiner		Brook stickleback	
Silver lamprey (a/l)		Mimic shiner		Threespine stickleback	
Northern brook lamprey (a/l)	7	Brassy minnow		**Perchichthyidae (Temp. bass)**	
Chestnut lamprey (a/l)		Fathead minnow		*White bass	
American brook lamprey (a/l)		Bluntnose minnow	15	*White perch	
Lepisosteidae (Gars)		Suckermouth minnow		**Centrarchidae (Sunfishes)**	
*Spotted gar		Silverjaw minnow		*Rock bass	4
*Longnose gar		Northern redbelly dace		*Green sunfish	
Amiidae (Bowfins)		Southern redbelly dace		*Pumpkinseed	
*Bowfin		Finescale dace		*Warmouth	
Clupeidae (Herrings)		Blacknose dace	35	*Orangespotted sunfish	
*Alewife		Longnose dace		*Bluegill	
*Gizzard shad		Redside dace		*Longear sunfish	
Salmonidae (Salmon/Trout)		*Pearl dace		*White crappie	
*Rainbow trout		**Cottidae (Sculpins)**		*Black crappie	
*Brown trout		Mottled sculpin		*Largemouth bass	
*Brook trout	8	Slimy sculpin		*Smallmouth bass	
*Coho		**Catostomidae (Suckers)**		**Percidae (Perch)**	
*Chinook		*Longnose sucker		N. sand darter	
Umbridae (Mudminnow)		*White sucker		Rainbow darter	
Central mudminnow		*Creek chubsucker		Iowa darter	
Esocidae (Pike)		*Lake chubsucker		Greenside darter	
*Grass pike		*Northern hog sucker		Fantail darter	15
*Northern pike		*Spotted sucker		Orangethroat darter	
*Muskellunge		*Silver redhorse		Johnny darter	
Cyprinidae (Minnows and Carp)		*River redhorse		Blackside darter	
Central stoneroller		*Black redhorse		Logperch	
Lake chub		*Golden redhorse		*Yellow perch	
*Goldfish		*Shorthead redhorse		*Walleye	
*Carp		*Greater redhorse		**Percopsidae (Trout-perch)**	
Bigeye chub		**Ictaluridae (Bullhead/Catfish)**		Trout-perch	
*Horneyhead chub	40	*Black bullhead		**Anguillidae (Eels)**	
*River chub		*Brown bullhead		*American eel	
*Creek chub	32	*Yellow bullhead		**Gadidae (Cod)**	
*Golden shiner		Stonecat		*Burbot	
Pugnose shiner		Tadpole madtom		**Sciaenidae (Drums)**	
Emerald shiner		Brindled madtom		*Freshwater drum	
Bigeye shiner		*Channel catfish		**Cobitidae (Loaches)**	
Ironcolor shiner		*Flathead catfish		Oriental weatherfish	
*Common shiner	22	**Aphredoderidae (Pirate perch)**		**Other family/species:**	
Central bigmouth shiner		Pirate perch		_____	
Blackchin shiner		**Atherinidae (Silversides)**		_____	
Blacknose shiner		Brook silverside		_____	
Spottail shiner		**Cyprinodontidae (Topminnows)**		_____	
Silver shiner		Banded killifish			
Rosyface shiner		Blackstripe topminnow			
Spotfin shiner				* = Measured length	

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T35 R24W S13

ERM

FISH SAMPLING DATA SHEET

Date: 6/25/9

Water body: Shakey Lakes/Resort Lake

Location: Stephenson, MI Resort Lake

Sample Station ID AQ5

Bank Sampled (River Only; looking upstream R or L): NA

Collectors: B. Rabe, M. Baker, J. Williams

GPS Start Location of Set: (Include datum): 16T 434993 5030597 [UTM, NAD83]

GPS End: —

Sampling Start Time: 2130 on 6/24/9

Sampling End Time: 1945 on 6/25/9

Gear Type: Fyke Net

Gear Comments: 50' Lead. Did not use wings

Weather Conditions: Sunny 70°F

Conductivity: (umhos) —

Secchi reading (ft): —

Comments/Notes:

- See attached Herps observation data sheet
- Several fish stuck in boxed entrance. Net was shaken down to collect fish from end of net. - Fish were stuck with a large snapping turtle.

Waterbody: Shakey Lakes - Desert Lake

Date 6/25/19 **Station ID:** AQ5

Gear: Fyke Net

Collectors: B Burke, M. Baker, J. Williams

Species:	Bluegill	Pumpkinseed	North. Pike	Brown Bullhead	Black Bullhead					
all fish per species listed by inch class	2 6	4	13	13	8					
	7 4	4		12	7					
	2 4	4								
	4 4	3								
	3 5	5								
	4 3	3								
	3 5	6								
	6 3	5								
	3 4	4								
	5 6	5								
	4 3									
	5 6									
	5 6									
	3 7									
	2 4									
	6 4									
	4 3									
	4									
	6									
	6									
	3									
	6									
	5									
	4									
	5									
	4									
Total:	43	10	1	2	2					

~~Stream Status and Trends Program~~
Herps observation

Revised 3/22/04

Water body: Resort Lake / Shakey Lakes Date: 6/25/19 Page 1 of 1

Station: AQ5 / Fyke Net

Crew[1] (first initial, last name): B. Rabe, M. Baker, J. Williams

Species	Number	Size[2]	Species	Number	Size[2]
Turtles:			Eastern Gray Tree Frog		
Snapping	1,1	14", 12"	Northern Spring Peeper		
Softshell			Western Chorus Frog		
Spotted*			Bullfrog		
Wood***			Green Frog		
Eastern Box***			Pickerel Frog		
Blandings***			Northern Leopard Frog		
Map			Mink Frog		
Painted	1,1,1,1	5", 6", 5", 5"	Wood Frog		
Red-eared Slider			Copes Gray Tree Frog		
Musk			Boreal Chorus Frog***		
Lizards:			**Snakes:**		
5-lined Skink			Kirtlands**		
6-lined Race Runner***			Copperbelly Water**		
Salamanders:			Northern Water		
Eastern Tiger			Queen		
Spotted			Brown		
Blue Spotted			Northern Red-bellied		
Marbled*			Eastern Garter		
Small-mouthed**			Butler's Garter		
Four-toed			Northern Ribbon		
Mudpuppy			Northern Ringneck		
Central Newt			Eastern Hognose		
Red-spotted Newt			Blue Racer		
Red-backed			Black Rat***		
Western Lesser Siren			Eastern Fox*		
Frogs and Toads:			Eastern Milk		
Eastern American Toad			Smooth Green		
Fowler's Toad			Eastern Massasauga***		
Blanchard's Cricket Frog***			Western Fox		

[1]Note any additional comments as necessary on back of sheet.
[2]Turtles: measure straight-line length of shell (end-to-end without measuring curve). All other herps: measure total length. Enter data under "Actual" column in the "Herps Observation" section of the Fish Collection System.

***Threatened** ****Endangered** *****Special concern**

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T35N R28W S 18, 19

ERM

FISH SAMPLING DATA SHEET

Date: 6/26/19

Water body: ~~Easy Lake~~ / Shakey Lake **Location:** Stephenson, MI

Sample Station ID AQC - East Lake **Bank Sampled (River Only; looking upstream R or L):** —

Collectors: B. Babe, M. Baker, J. Williams

GPS Start (Include datum): * See GPS points below **GPS End:** * See GPS points below

Sampling Start Time: 2150 **Sampling End Time:** 0016

Gear Type: Boom shocker **Gear Comments:** TOTAL shock time = 1,976 seconds = 32.9 minutes

Weather Conditions: ~~Clear~~ Sunny 75°C

Conductivity (umhos): 345 (27.9°C) **Secchi reading (ft):** —

Slope 1.002 (Calibration 1401 @ 27.3°C

Comments/Notes: ** : Very thick weed pin entire shocking area; needed to stop frequently to clean weeds off motor

1st stop @ (GPS 029) AQ6 STOP1 → 670 sec to 2226.1 60pps / 4 pwidth / 530 V

2nd stop (GPS 30) AQ6 STOP2 → 649.5 sec — same parameters

3rd stop (GPS 031) AQ6 STOP3 → 657 sec — same parameters

GPS AQ6 start1 @ 16T 435916 5030177 - GPS AQ6 stop1 @ 16T 436280 5029857
GPS AQ6 start2 @ 16T 436280 5029857 - GPS AQ6 stop2 @ 16T 436349 5030275
GPS AQ6 start3 @ 16T 436349 5030275 - GPS AQ6 stop3 @ 16T 435887 5030212

[UTM, NAD 83]

7/3/19
6/27/19
6/24/19

Waterbody: Shakey Lakes- East Lake
Date 6/26/9 **Station ID:** ~~AQ6~~ - East Lake
Gear: Boom Shocker
Collectors: B. Rabe, M. Baker, J. Williams

• all fish species listed by inch class

Species:	Largemouth Bass	Black Crappie	Pumpkinseed	Bluegill	Yellow Perch	Bowfin	Golden Shiner	Hornyhead Chub	Black Bullhead	Brown Bullhead
	14	6	4 3 5	4 4 4	5 3	26	4	3 (1)	10	12(1)
	10	8(1)	3 4 3	5 2 5	3 3	20	3	3(2)	9 (1)	10
	16		6 3 3(2)	5 3 3	3 3	24(1)	2(1)		10(2)	9(2)
	17		5 4 6	2 4 3	4 5		4(6)			7
	16(1)		4 4 4	3 4 3	4 4		2			8
	11		4 3 6	6 3 3	4 1(2)					
	15		6 4 4	5 4 3	3 1					
	15(2)		4 5 4	4 5 3	4 4					
	10		4 4 4	1 4 3	4 3					
	9		6 5 4	4 5 4	3 6					
	14		4 5 4	3 6 1	4(1)					
	12		4 4 4	5 4 5	3 3					
	12		5 4 4	1 4 4	3 4					
	15		3 1 4	5 4 5	3 5					
	17		4 4 3	5 4 4	3 1					
			3 4 3	4 4 8	4					
			4 3 4	4 5 5	3					
			3 4 3	4 4 4	3					
			5 4 3	5 1 4	3					
			3 5 3	3 4 1	4					
			3 4 3	5 4 1	4					
			3 4 3	4 4 6	4					
			3 5	1 4 4	3					
			5 3	4 5 3	3					
			3 3	4 5 3	5					
			3 3	4 1 4	3					
Total:	15	2	74	136 *	41	3	5	2	3	5

Waterbody: Shakey Lakes - East Lake
Date 6/26/9 **Station ID:** A06 - East Lake
Gear: Boom shocker
Collectors: B. Korbe, M. Baker, J. Williams

Species:	Iowa Darter	Northern Pike	Bluegill	Rock Bass	Johnny Darter	Western Lake Chubsucker	Central Mudminnow			
	2(1)	1(1)	6 5 1	4(2)	2(1)	4	23			
		11	3 4 4							
			1 5 3							
			4 4 5							
			4 5 3							
			4 3 3							
			5 5							
			4 5							
			5 4							
			3 3							
			4 3							
			3 5							
			3 5							
			2 5							
			3(2) 3							
			4 3							
			4 3							
			5 3							
			4 4							
			4 5							
			4 5							
			3 2							
			5 3							
			4 4							
			4 5							
			5 5							
Total:	1	2	*	1	1	1	1			

* Total Number listed at first species column

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T35N R28W S 18, 19

ERM

FISH SAMPLING DATA SHEET

Date: 6/25/19

Water body: Shakey Lakes / CRESTLAKE **Location:** Stephenson, MI

Sample Station ID AQ6 - CREST LAKE **Bank Sampled (River Only; looking upstream R or L):** —

Collectors: B. Rake, M. Baker, J. Williams

GPS Start Set Location: **(Include datum):** 16 T 436189 5030376 [UTM, NAD 83] **GPS End:** —

Sampling Start Time: Net Set @ 2030 on 6/24/19 **Sampling End Time:** Net pulled @ 2030 on 6/25/19

Gear Type: Fyke Net **Gear Comments:** 50' Lead; No wings used 1/2" mesh

Weather Conditions: Clear · Dark 70°F

Conductivity: (umhos) 345 **Secchi reading (ft):** ~

Calibration: slope = 1.002; 1413 standard = 1403 @ 27-30°C

Comments/Notes:

- few turtles; No snapping turtle
- 2 Northern Pike and several fish stuck in boxed entrance. Fish/Nets were shaken down to collect fish from end of net.
- Net set in dense aquatic vegetation: coontail + potam. sp.
- See attached herps observation form.

Waterbody: Shakey Lakes - East Lake
Date 6/25/9 **Station ID:** A06
Gear: Fyke Net (EAST Lake)
Collectors: B. Rahe, M. Baker, J. Williams

Species:	Northern Pike	Bluegill	Black Crappie	Pumpkinseed	Bluegill	Brown Bullhead				
	18	5 4 3	11	5	4 4	10				
	24	5 4 6		6	5 4					
6" panfish	18	3 3 3		4	4 5					
5" panfish	25	5 4 5		3	4 3					
	8	5 3 4		4	2 4					
		6 3 3		8	5 4					
		4 3 3		4	5 7					
		4 4 5		4	4 6					
		5 4 3		4	5 4					
		5 5 3		4	3 5					
		4 5 4		6	3 3					
		5 6 3		3	4 5					
		2 4 4		5	6					
		3 3 5		5	3					
		3 3 3		6	5					
		4 2 5		3	5					
		5 5 3		7	4					
		3 6 3		4	3					
		7 4 4		4	6					
		4 4 7		3	4					
		4 3 4		3	5					
		4 3 2		5	5					
		4 3 3		5	3					
		4 3 5		3	3					
		5 4 3			3					
		3 4 2			6					
Total:	5	116 *	1	24	*	1				

* Total number listed at first species column

ERM

~~Stream Status and Trends Program~~

Herps observation

Revised 3/22/04

Water body: Shakey Lakes - East Lake Date: 6/25/09 Page 1 of 1

Station: AC06 - East Lake - [Fyke Net]

Crew[1] (first initial, last name): _____

Species	Number	Size[2]	Species	Number	Size[2]
Turtles:			Eastern Gray Tree Frog		
Snapping			Northern Spring Peeper		
Softshell			Western Chorus Frog		
Spotted*			Bullfrog		
Wood***			Green Frog		
Eastern Box***			Pickerel Frog		
Blandings***			Northern Leopard Frog		
Map			Mink Frog		
Painted	1, 1	6", 5"	Wood Frog		
Red-eared Slider			Copes Gray Tree Frog		
Musk			Boreal Chorus Frog***		
Lizards:			**Snakes:**		
5-lined Skink			Kirtlands**		
6-lined Race Runner***			Copperbelly Water**		
Salamanders:			Northern Water		
Eastern Tiger			Queen		
Spotted			Brown		
Blue Spotted			Northern Red-bellied		
Marbled*			Eastern Garter		
Small-mouthed**			Butler's Garter		
Four-toed			Northern Ribbon		
Mudpuppy			Northern Ringneck		
Central Newt			Eastern Hognose		
Red-spotted Newt			Blue Racer		
Red-backed			Black Rat***		
Western Lesser Siren			Eastern Fox*		
Frogs and Toads:			Eastern Milk		
Eastern American Toad			Smooth Green		
Fowler's Toad			Eastern Massasauga***		
Blanchard's Cricket Frog***			Western Fox		

[1]Note any additional comments as necessary on back of sheet.
[2]Turtles: measure straight-line length of shell (end-to-end without measuring curve). All other herps: measure total length. Enter data under "Actual" column in the "Herps Observation" section of the Fish Collection System.

***Threatened** ****Endangered** *****Special concern**

T35N R28W S19

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ERM

FISH SAMPLING DATA SHEET

Date: 6/25/9

Water body: Shakey Lakes / Baker Lake **Location:** Stephenson, MI

Sample Station ID AQ7 - Baker Lake **Bank Sampled (River Only; looking upstream R or L):** ←

Collectors: B. Lake, M. Baker, J. Williams

GPS Start (Include datum): * See GPS points below **GPS End:** * See GPS points below

Sampling Start Time: 1200 **Sampling End Time:** 1200

Gear Type: Boom Shocker **Gear Comments:** Shock TIME = 1,417 seconds = 23.6 Minutes

Weather Conditions: cloar; 70's / Dark

Conductivity (umhos): 233 @ 28.1°C **Secchi reading (ft):** ——

Comments/Notes:

1st stop @ (AQ7 stop 1 GPS-025) - 389 Sec

2nd stop (AQ7 stop 2 GPS-026) - 525 Sec

3rd stop (AQ7 stop 3 GPS-027) 503 Sec

60 pps, 4 Pulse width, (35% DC), 530V
same setting for 2 & 3

* GPS AQ7 Start 1 @ 16T 436566 5029490 GPS AQ7 Stop 1 @ 16T 436792 5029665
GPS AQ7 Start 2 @ 16T 436792 5029665 GPS AQ7 Stop 2 @ 16T 436611 5029807
GPS AQ7 Start 3 @ 16T 436581 5029799 GPS AQ7 Stop 3 @ 16T 436477 5029489

[UTM, NAD83]

Waterbody: Shakey Lakes - Baker Lake
Date 6/25/9 **Station ID:** AQ7 - Baker Lake
Gear: Boom shocker
Collectors: B. Kabe, M. Baker, J. Williams

Species:	Bluegill	Rock Bass	Pumpkinseed	Yellow Perch	Golden shiner	Black crappie	Yellow perch	LM Bass	Bowfin	Common shiner
	6 5 4	24 (1)	5	3 3 4	2	6	4 3 3	12*	22	2 (1)
	5 4 3	6 (2)	5	3 3 6	1 (1)	8 (1)	4 4 3	8	27 (1)	3
5" pmot	3 3 3	5	6	4 3 4		11	3 3 3	19	23	4
	4 2 2		4	3 3 3			5 4 3	12*	24	1
	5 6 4		3 (1)	7 3 4			4 4 4	4		2
	4 6 5		5	5 3 4			4 3 3	11		2
	1 5 1		4	5 3 3			5 3 2	5		1
	4 4 3		4	3 3 3			2 4 5	3 (1)		2
	5 4 3		4	3 3 3			3 4 3	10		3
	1 5 5		5	3 3 3			2 5 5	3		1
	3 2 3		4	4 3 3			4 4 5	9		1
	4 5 2		6	6 3 4			4 3 (1) 6	6		1 (2)
	3 4 6		4	4 5 4			5 5 3	13*		2
	5 7 2		3	3 5 2			5 3 3	7		1
	3 4 5		4 (2)	3 3 3			3 5 3	13*		2
	6 3 4		5	3 3 3			5 3 5	11 (2)		
	3 3 2		5	6 3 5			5 5 4	17*		
	7 3 3		6	5 3 6			5 4 3	11		
	3 (2) 3 16		4	2 3 5			3 3 3	11		
	3 1 3		3	3 7 4			4 4 3	7		
	2 3 1		5	3 5 4			5 3 3	14		
	4 5 4		4	3 3 5			4 5 3	18		
	3 2 4			3 3 3			4 4 5	9		
	4 3 3			4 3 3			3 4 6			
	4 3 3			5 3 3			5 3 3			
	1 7 1			4 5 5			5 3 3			
Total:	110*	3	22	320*	2	3	*	23	4	15

Waterbody: Shakey Lakes - Baker Lake
Date 6/25/9 **Station ID:** AQ7 - Baker Lake
Gear: Boom shocker
Collectors: B. Lake, M. Bakey, J. Williams

Species:	Yellow Perch	Yellow Perch	Bluegill	Fowa Darter	Johnny Darter	Yellow Perch				
	3 4 3	4 3 5	3 4	2(2)	2(2)	2				
	4 4 3	3 3 4	6 3		2(2)	3				
	6 6 4	3 3 4	3 3			3				
	4 5 3	3 3 3	2 6			4				
	2 5 3	4 5 4	5 3			3				
	4 6 4	5 3 3	4 1			3				
	4 5 3	3 3 3	2			3				
	4 3 5	3 5 5	4			3				
	4 4 3	3 5 4	3							
	3 3 3	3 3 5	3							
	5 3 3	3 3 2	5							
	5 2 3	2 2 3	6							
	4 3 4	3 4 3	3							
	5 3 4	4 5 5	7							
	4 5 4	3 3 3	4							
	3 4 4	3 3 5	4							
	3 4 3	3 3 3	2							
	3 4 3	3 5 3	5							
	4 3 5	2 5 4	4							
	3 3 5	3 4 3	4							
	3 3 4	3 5 3	3							
	3 3 4	2 5 3	4							
	5 3 5	3 2 4	4							
	5 4 5	3 3 3	3							
	6 3 4	4 3 3	3							
	3 2 3	5 5 3	2							
Total:	*	*	*	1	2	*				

* Total number listed at first species column. • fish contaminant samples

Environmental Resources Management, Inc.
23352 128th Avenue
Holland Michigan 49424
616.399.3500
616.399.3777 (fax)

T35N R28W S19

ERM

FISH SAMPLING DATA SHEET

Date: 6/25/9

Water body: Baker Lake / Shakey Lakes

Location: Stephenson, MI

Sample Station ID AQ7 - Baker Lake

Bank Sampled (River Only; looking upstream R or L): —

Collectors: B. Parker, M. Baker, J. Williams

GPS Start Location (Include datum): 16T 436561 5029485 [UTM, NAD 83]

GPS End: —

Sampling Start Time: Net set @ 0930 on 6/24/9

Sampling End Time: Net pulled @ 2130 on 6/25/9

Gear Type: Fyke Net

Gear Comments: 50' Lead, no wings 1/2" Mesh

Weather Conditions: Sunny 75°F

Conductivity (umhos): 233 @ 28.1°C

Secchi reading (ft): —

Comments/Notes:

- See herps observation form; attached
- low, bottom covering vegetation surrounding net set; Najas + Chara

Waterbody: Shakey Lakes - Baker Lake
Date 6/25/9 **Station ID:** AQ7 - Baker Lake
Gear: Fyke Net - Baker Lake
Collectors:

Species (inches)	Northern Pike	Bluegill	Rock Bass	Pumpkinseed	Black Crappie					
	26	2 3 4	7	4	7					
		2 3 4	~~5~~ JW	3	5					
(6" Painted 4" Painted)		3 2 2	6	3						
		4 3 2	6	3						
		2 4 3		4						
		2 3 3								
		5 3 3								
		3 3								
		4 5								
		2 4								
		4 4								
		3 3								
		2 4								
		2 4								
		2 3								
		3 2								
		3 3								
		3 3								
		2 6								
		2 4								
		3 2								
		3 4								
		3 3								
		2 3								
		6 2								
		3 4								
Total:	1	59	3	5	2					

ERM

~~Stream Status and Trends Program~~

Herps observation

Revised 3/22/04

Water body: Shakey Lakes - Baker Lake Date: 6/25/9 Page 1 of 1

Station: AQ 7 - Baker Lake

Crew[1] (first initial, last name): B. Kabo, M. Baker, J. Williams

Species	Number	Size[2]	Species	Number	Size[2]
Turtles:			Eastern Gray Tree Frog		
Snapping			Northern Spring Peeper		
Softshell			Western Chorus Frog		
Spotted*			Bullfrog		
Wood***			Green Frog		
Eastern Box***			Pickerel Frog		
Blandings***			Northern Leopard Frog		
Map			Mink Frog		
Painted	1, 1	6", 4"	Wood Frog		
Red-eared Slider			Copes Gray Tree Frog		
Musk			Boreal Chorus Frog***		
Lizards:			**Snakes:**		
5-lined Skink			Kirtlands**		
6-lined Race Runner***			Copperbelly Water**		
Salamanders:			Northern Water		
Eastern Tiger			Queen		
Spotted			Brown		
Blue Spotted			Northern Red-bellied		
Marbled*			Eastern Garter		
Small-mouthed**			Butler's Garter		
Four-toed			Northern Ribbon		
Mudpuppy			Northern Ringneck		
Central Newt			Eastern Hognose		
Red-spotted Newt			Blue Racer		
Red-backed			Black Rat***		
Western Lesser Siren			Eastern Fox*		
Frogs and Toads:			Eastern Milk		
Eastern American Toad			Smooth Green		
Fowler's Toad			Eastern Massasauga***		
Blanchard's Cricket Frog***			Western Fox		

[1]Note any additional comments as necessary on back of sheet.
[2]Turtles: measure straight-line length of shell (end-to-end without measuring curve). All other herps: measure total length. Enter data under "Actual" column in the "Herps Observation" section of the Fish Collection System.

***Threatened** ****Endangered** *****Special concern**

Environmental Resources Management, Inc.
23352 128th Avenue
Holland Michigan 49424
616.399.3500
616.399.3777 (fax)

T35N R29W S13

ERM

FISH SAMPLING DATA SHEET

Date: 6/24/9

Water body: Shakey Lakes **Location:** Resort Lake

Sample Station ID AQ5 **Bank Sampled (River Only; looking upstream R or L):** NA

Collectors: D. Kalsey, M. Baker, J. Williams

GPS Start (Include datum): UTM, NAD83 *See below **GPS End:** *See below

Sampling Start Time: 2200 **Sampling End Time:** 0190

Gear Type: Boom shocker [Night shock] **Gear Comments:** TOTAL shock time = 1,463 sec. = 24.4 min.

Weather Conditions: Clear 80°F (Night)

Conductivity: (umhos) 329 @ 27.6 °C **Secchi reading (ft):** —

Comments/Notes:

1st stop: 702 sec 60pps 4 Pulse width, 707 V (25% DC) ~10A

2nd stop 287 gpsoff 237 sec 60pps 4 PWidth, 530V (25% DC) (~8-10A)

3rd stop 474 Same as above (2nd stop)

GPS start 1 = 16T 435026, 5030589 / GPS stop 1 = 16T 434886, 5030452
GPS start 2 = 16T 434886, 5030452 / GPS stop 2 = 16T 435153, 5030462
GPS start 3 = 16T 435200, 5030551 / GPS stop 3 = 16T 435019, 5030658

Fyke NET: Set 1 Fyke NET @ GPS AQ5 Fyke 1 (16T 434993, 5030597) @ ~2130

Comments: shocked around perimeter of Lake, along shore line. Shocked while heading in to thick weed/woody debris habitat. Turned off shocker and backed out of habitat. Needed to make frequent stops to clear weeds off of jet motor intake. Did not shock across deep opening to lake. Did not shock in weed-choked woody debris on North side of Lake.

Waterbody: Shakey Lakes / Resort Lake
Date 6/24/9 **Station ID:** AQ5 - Resort Lake
Gear: Boom shocker
Collectors: B. Kalso, M. Baker, J. Williams
• All Fish listed in inch class

* all Fish species listed by inch class

Species:	Bluegill	Largemouth Bass	Pumpkinseed	Common shiner	Bowfin	Central mudminnow	Northern Pike	Yellow Perch	Black Bullhead	Golden shiner
	4 11 3	11"	5 2	4 (1)	23 (2)	3 (1)	9 (2)	4 4	9	5
	4 3	13	4 4	1	29	2	1 (3)	3 3	9	3
	3 3 (1)	6 (1)	5 4 (1)	1	23 (2)	2		5 4	9 6)	3
	5 4	9	3 3	1 (6)	22 (2)	2 (1)		3 3	9	2
	4 1	18	4 6	2		2		4 4	3	4 (2)
	2 4	12"	4 4	2		3		1 3	7 (3)	3
	3 1	1	4 3	3 (3)		2		4 4		4
	4 1	1	4 4			2		3 3		5
	3 4	12 (1)	6 3			2		5 4		4 (3)
	4 7	13"	3 4			2		3 4		
	4 3	3	4 4			3		4 4		
	3 3	3	4 (1) 7			2		4 3		
	6 5	14"	3 4			2		3 6		
	4 3	1 (3)	4 4			2 (3)		1 5		
	3 1		4 4					4 3		
	4 4		5 5					3 3		
	1 4		6 4					4 3		
	5 1		5 4					3 1		
	4 4		3 4					3 3		
	2 3		4 3					3 1		
	4 5		6 3					3 (2) 3		
	5 1		4 4					3 3		
	2 3		3 4					3 4		
	3 3..		2 4					3 1		
	5 6		5 4					1 1		
	4 5		2 4					4 1 *		
Total:	270 *	14	98 *	7	4	14	2	71 *	6	9

Waterbody: Shakey Lakes - Resort Lake

Date 6/24/19 **Station ID:** AQS - Resort Lake

Gear: Boom Shocker

Collectors: B. Baker, M. Baker, J. Williams

Aquatic Biologists

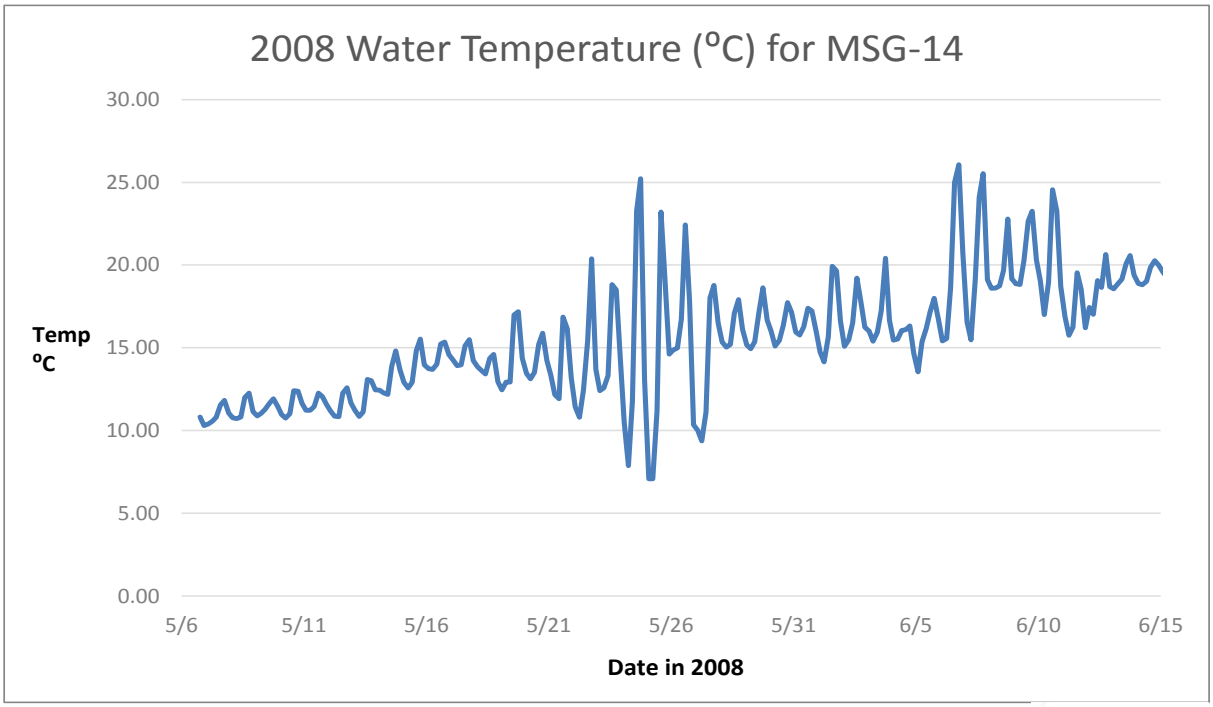
Species:	Bluegill	Brown Bullhead	Rock Bass	Yellow Perch	Black Crappie	Hornyhead Chub	Bluegill	Pumpkinseed	Fowl Pox	Bluegill
	5 2 1	11.	9(2)	3	9(3)	4(Pc)3	1 5 4	4 4	2	5 5 1
	4 1 3	11(2).	6	1			1 5 3	3 3	2	4 4 3
	5 3 1	10.	9	1			7 3 5	4 3	2(2)	3 2 3
	2 4 4	9(3).	8	1			3 3 5	5 4		7 1 3
	3 1 5		7	3			3 6 4	4 6		4 1 4
	5 1 1		6	3			3 3 7	3 3		4 4 1
JW	4 1 4		7(3)	3			2 5 5	4 3		4 7 1
	5 3(6) 5			4			5 4 5	3 4		3 3 4
	1 4 3			1			6 5 4	4 3.		2 4 1
	3 3 4			1			4 3 1	4 4		8 3 1(3)
	5 2 4			1			4 1 6	5 4		6 2
	5 5 4			4			4 5 4	3 3		2 1
	3 3 5			4			6 4 6	4 4		4 3
	5 1 2			3			3 7 5	7 3		5 3
	4 3 3			3			2 4 5	4 3		5 4
	4 2 3			5			4 4 5	3 2		6 4
	4 2 5			3			5 5 5	7 1		4 1
	3 1 3			3			3 3 5	5 3		3 1
	3 5 5			4(3)			4 3 5	4 3		1 3
	3 5 5						1 2 3	4 5(3)		3 2
	3 3 4						5 4 3	4		4 1
	4 4 2						4 3 6	4		3 3
	5 4 4						4 1 4	7		5 1
	1 4 3						3 2 4	7		3 2
	1 4 3						7 1 5	4		6 1
	1 5 5						7 2 3	3		2 3
Total:	*	4	7	*	1	1	*	*	3	*

* Total number listed at first species column • Fish Contaminant Samples

Attachment 94

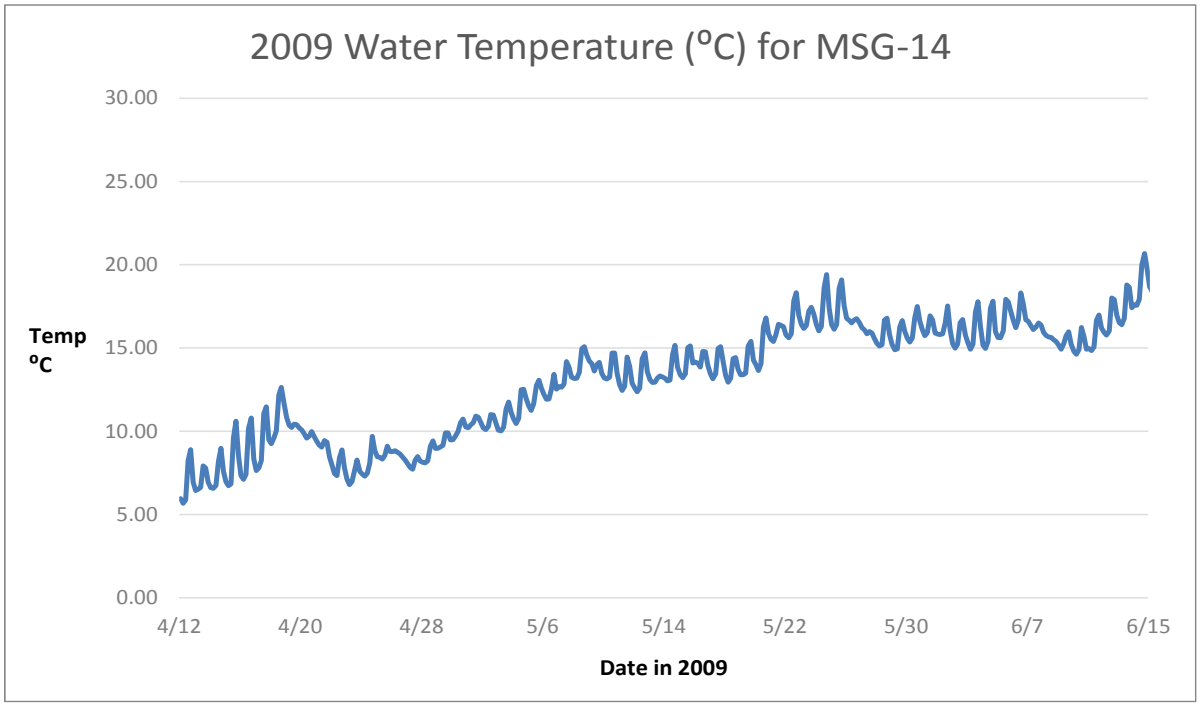
Environmental Resources Management

Figure 94-1



Environmental Resources Management

Figure 94-2



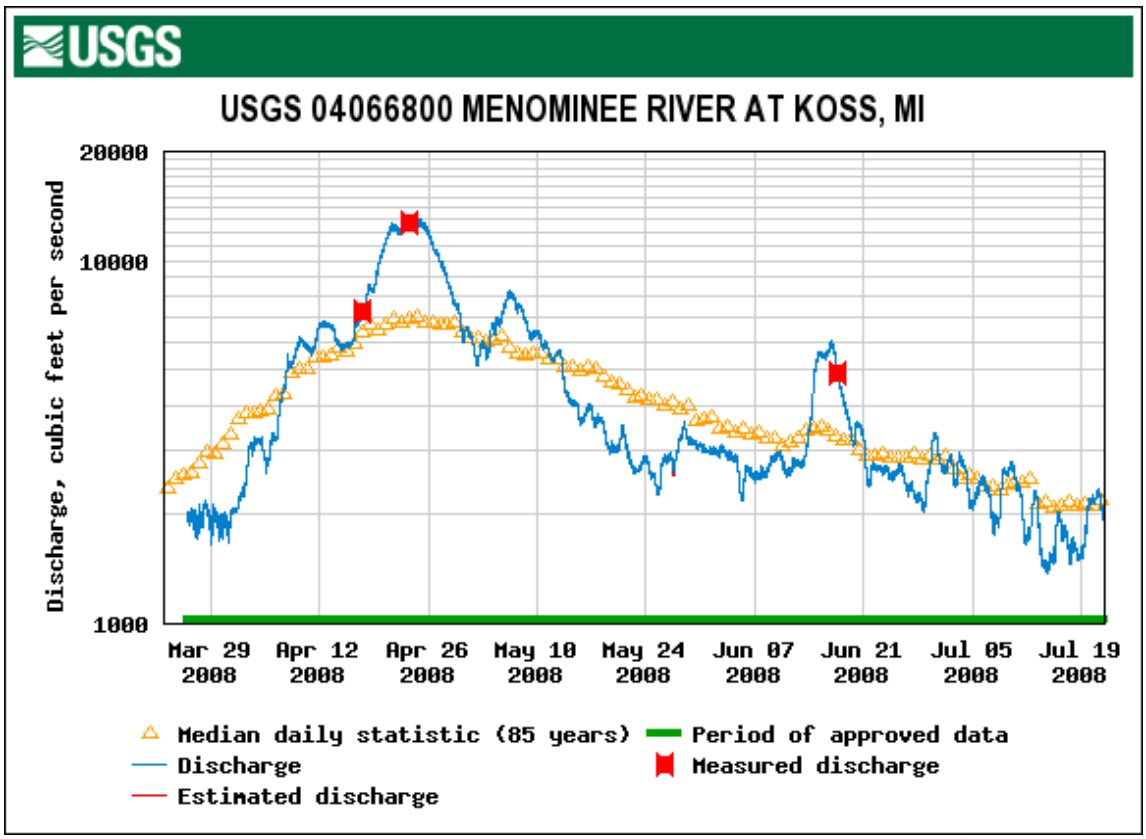
ERM

https://portals.foth.com/aquila/0014a021.15/ProjectDocumentsInternalAccessOnly/10000 Reports/Request for Add'l Information/Response Request Attachments/Figures 94-1 and 94-2 ERM .xlsx

Attachment 99

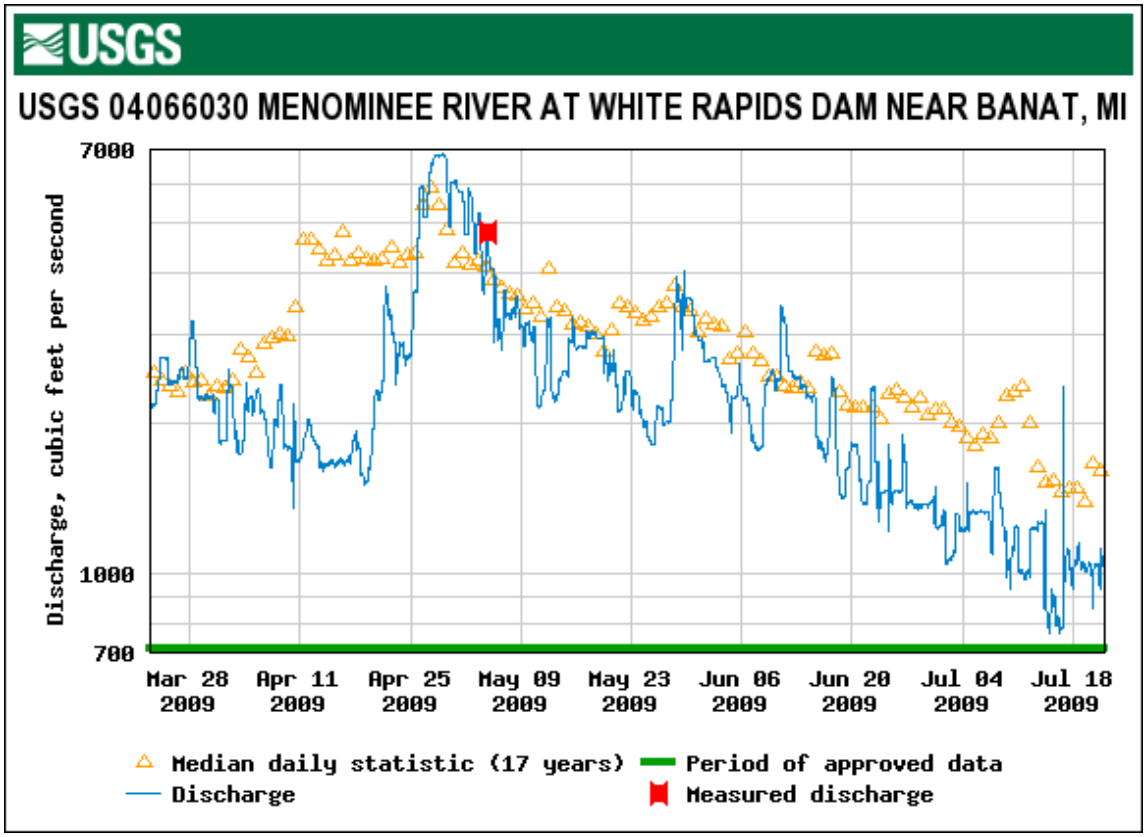
Environmental Resources Management

Figure 99-1



Environmental Resources Management

Figure 99-2



Attachment 101

MI DNR Dr. Ed Baker revised as of 6/8/2016

The estimated abundance of all lake sturgeon in the reach of Menominee River from White Rapids dam downstream to Grand Rapids dam is:

Total Abund	Stnd Error	95% Conf Interval Lower	Upper
4,036	402.9	3320.8	4906.4

The abundance for just adults (defined as fish 50" and larger) is:

Total Abund	Stnd Error	95% Conf Interval Lower	Upper
417	49.1	331.0	524.4

The estimate is based on mark/recapture data (with PIT tags) collected from 1999-2016. Data were collected during spawning season most years and during occasional summer surveys. The estimate was generated using the POPAN routine in program MARK. The abundance for just adults (defined as fish 50" and larger) is:

WI DNR - Dr. MIKE DONOFRIO Email 6/2/2016

1) Annual spring electrofishing surveys to collect adults for use in our propagation program. We hold adults until we have ripe males and females. We fertilize those eggs in the field, disinfect them and bring them to our Wild Rose hatchery. We later stocked the progeny into the upper Menominee river (from Sturgeon Falls to Chalk Hills dams).

2) During that time period, we conducted 2 summer electrofishing surveys with MIDNR. On July 26, 2012, we collected, tagged and released 310 lake sturgeon from 14.2 to 63 inches in total length. The average size was 35.3 inches and 113 or 36.5% of those fish were less than 30 inches in total length. On July 21, 2015, we collected, tagged, and released 133 lake sturgeon from 16.5 to 63.5 inches in total length. The average size was 36.8 inches and on that day, 46 or 34.6% of those fish were less than 30 inches in total length. I believe the reduction in the number of fish caught in 2015 is not an indication of a smaller population but likely higher flows and water levels that made fish less vulnerable to capture. Since we have been marking the stocked fish from up river, we have a good indication if a juvenile sturgeon is naturally produced. In 2012, only 6 of those 113 juvenile fish were marked. In 2015, only 3 of those 46 juvenile fish were marked. I think most of the sturgeon caught during these surveys were naturally produced.

2012 PE for this section of the Menominee river

Group	N	SE	Lower 95% CI	Upper 95% CI
All Fish	2952	431	2107	3797
>=36"	1326	194	946	1707
>=42"	914	135	649	1178
>=50"	272	43	188	356

3) The only telemetry performed was the work you conducted in 2012 with the We Energies project.

4) We did not set nets for larval sturgeon.

Attachment 107

Stantec Consulting Services Inc.
1165 Scheuring Road
De Pere, WI 54115
Tel: (920) 592-8400
Fax: (920) 592-8444

June 2, 2016

Mr. Kris Baran, Senior Project Manager
Foth Infrastructure & Environment, LLC
2121 Innovation Court, Suite 300
P.O. Box 5126
De Pere, WI 54115-5126

Reference: Proposed Bat Acoustic Survey and Habitat Assessment Study Plan
Back Forty Mine Project 193703271
Menominee County, Michigan

Dear Mr. Baran:

Stantec Consulting Services Inc. (Stantec) has been retained by Foth Infrastructure & Environment, LLC (Foth) on behalf of Aquila Resources, Inc. (Aquila) to prepare a study for the federally threatened northern long-eared bat (*Myotis septentrionalis*) prior to development of the Back Forty Mine Project (Project). The Project is located within Sections 6 and 7 of Lake Township (Township 35 N, Range 28 W) and Sections 1 and 12 of Lake Township (Township 35 N, Range 29 W) in Menominee County, Michigan (Figure 1).

The purpose of the study plan is to develop an approach to assess potential summer habitat, assess potential winter roost locations, and complete an acoustic bat survey to determine summer presence or probable summer absence of the northern long-eared bat within the project area. This letter outlines the proposed study plan for the habitat assessments and acoustic survey.

SITE DESCRIPTION

The project area consists of an approximate 865 acre parcel proposed for construction of a new mine facility. This parcel is irregularly shaped and extends eastward from the Menominee River to west of County Road 356. The site was characterized in previous reports (ERM 2009, Stantec 2015) as open upland habitat or clearing and mixed hardwood forest habitat. The canopy is dominated by sugar maple (*Acer saccharum*) and less commonly by red maple (*Acer rubrum*) and basswood (*Tilia americana*). Canopy coverage ranges from 60-70 percent in the southern portion to 80-90 percent in the northern portion. Land management activities (i.e., forest clear cuts) have created an open canopy landscape. Approximately 800 acres of the project area contains woodland habitat.

Reference: Study Plan for Bat Acoustic Surveys and Habitat Assessment
Back Forty Mine Project
Menominee County, Michigan

METHODS

Summer Habitat Assessment

A Phase I Habitat Assessment, following methods set forth in the U.S. Fish and Wildlife Service (USFWS) 2016 Range-Wide Indiana Bat Summer Survey Guidelines (USFWS 2016) will be conducted within the project area. As per the guidelines, the protocols can also be used for northern long-eared surveys during the 2016 field season. Northern long-eared bats typically occupy their summer habitat from mid-May through mid-August each year.

Suitable summer habitat for the northern long-eared bat consists of a variety of forested/wooded habitats where they roost, forage, and travel, as well as surrounding non-forested habitats (e.g., agricultural fields, emergent wetlands, old fields, pasture). This includes forests, woodlots, or wooded corridors containing potential roosts (i.e., live trees and/or snags that have exfoliating bark/cracks/crevices/hollows). These wooded areas may be dense or loose aggregates of trees greater than approximately ≥5 inch diameter at breast height (DBH) with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet of other suitable habitat.

Walking surveys will be conducted within the project area by a qualified Stantec biologist to identify suitable northern long-eared bat summer habitat. General data related to landscape, forest cover, including dominant tree species, potential roost trees, and water resources will be recorded along with representative site photos taken. Suitable habitat found within the project area will be mapped with a GPS unit when possible, or sketched on aerial photographs. If no roosts are identified within the project area but permanent water and adequate forest characteristics (per the guidelines) are present, the woodland would be deemed suitable northern long-eared bat summer habitat based on the likelihood that at least one dead or live tree with suitable peeling bark would be present in proximity to the project area.

Habitat assessment walking surveys will be completed prior to, and concurrently, with acoustic bat surveys. Habitat determined suitable, and having the highest likelihood of northern long-eared bat activity, will be used as sites for the acoustic detectors.

Acoustic Bat Survey

Acoustic presence/absence bat surveys using methods described in guidelines will be conducted within the project area. As per the guidelines, the protocols can also be used for northern long-eared bat presence/probable absence surveys during the 2016 field season.

The guidelines state that for non-linear projects acoustic surveys should include a minimum of 4 detector nights per 123 acres of suitable summer habitat. It is Stantec's understanding that the project area consists of approximately 800 acres of woodland habitat that may be suitable

northern long-eared bat summer habitat; therefore, a total of 7 survey locations will required (800/123 = 6.5[1]).

Stantec will conduct an acoustic survey in suitable summer habitat at 7 locations distributed across the project area. At each survey site, 2 acoustic detectors will be deployed for a minimum of 2 calendar nights (4 detector nights) at each of the 7 sites (total of 28 detector nights). The detectors will be active from 30 minutes prior to sunset to 30 minutes after sunrise each night of sampling. Acoustic sites will be distributed at least 656 feet (200 meters) apart within the project area. If feasible, all 7 locations will be surveyed during the same calendar nights.

Weather will be monitored by the nearest NOAA National Weather Service Station to document compliance with required weather criteria outlined in the guidelines. One night of recording will be considered in compliance with weather criteria when conditions meet the following within the first 5 hours of recording:

- Air temperature of at least 10°C (50°F)
- Precipitation of less than 30 minutes in duration, or intermittently
- Sustained wind speed of < 9 mph

If the weather conditions are not met during any sample night, additional survey nights will be sampled until each site has 4 detector nights with appropriate weather conditions.

Acoustic data collected at each site will be analyzed both quantitatively and qualitatively to assess the potential presence or probable absence of northern long-eared bats. Each data file will be processed to screen noise files. Bat call analysis will consist of processing recorded calls through one or more of the USFWS accepted auto-identification programs as per the guidelines. Calls identified as a northern long-eared bat by an accepted auto-identification program will be qualitatively analyzed by a qualified Stantec biologist to confirm identification.

For each site/night that at least one program considered northern long-eared bat presence likely (i.e. a positive northern long-eared bat call was qualitatively identified), a review of all files from that site/night will be completed. If more than one program is used, qualitative analysis will include a comparison of the results of each acoustic identification program by site and by night. This analysis will include: the number of call files flagged as probable northern long-eared bats by each tool used, an evaluation of other species identified by the acoustic identification program, individual file level agreements and disagreements on northern long-eared bat calls between programs, and a qualitative analysis of all probable northern long-eared bat call sequences to further evaluate that the correct identification has been made by the program used.

Winter Roost Habitat Assessment

According to the guidelines, northern long-eared bats may use caves, crevices, fissures, sinkholes, or abandoned mines as potential fall or winter habitat. A winter roost habitat assessment will be

[1] Rounded up to nearest whole number to ensure adequate survey effort.

Reference: Study Plan for Bat Acoustic Surveys and Habitat Assessment
Back Forty Mine Project
Menominee County, Michigan

conducted concurrently with the summer habitat assessment to determine if any potential winter roost habitat is observed within the project area. Suitable winter habitat will be photographed and mapped with a GPS. When possible, roost characteristics (i.e., depth, width of opening) will be recorded.

Report

A final report documenting the methods and results of the northern long-eared bat habitat assessment and surveys, including methods, results, supporting data sheets and figures will be prepared for submission to the resource agencies.

PROJECT SCHEDULE

The summer survey season is from approximately mid-May through mid-August. The summer habitat and winter roost assessment would be completed concurrently with the acoustic surveys. Fieldwork is estimated to take up to two weeks to complete. The final report and associated maps would be submitted after completion of the fieldwork.

If you have any questions, or require any additional information, please feel free to contact Jon Gumtow at (920) 980-2800 or me at (319) 334-3755.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Terry J. VanDeWalle
Senior Biologist/Senior Associate
terry.vandewalle@stantec.com

Jon Gumtow, PWS, PSS
Senior Scientist
jon.gumtow@stantec.com

Attachment: Figure 1

Reference: **Study Plan for Bat Acoustic Surveys and Habitat Assessment**
Back Forty Mine Project
Menominee County, Michigan

LITERATURE CITED

ERM/Walton, G. B. 2009. Draft Vegetation Habitat Surveys and Rare Species Report, Back Forty Project, October 2009

Stantec Consulting Inc. 2015. Back Forty Mine Project – 2015 Habitat Assessment and Rare/Invasive Plant Survey. Menominee County, Michigan, October 2015.

U.S. Fish and Wildlife Service (USFWS). 2016. Range-wide Indiana Bat Summer Survey Guidance dated April 2016. U.S. Fish and Wildlife Service. 48 pp

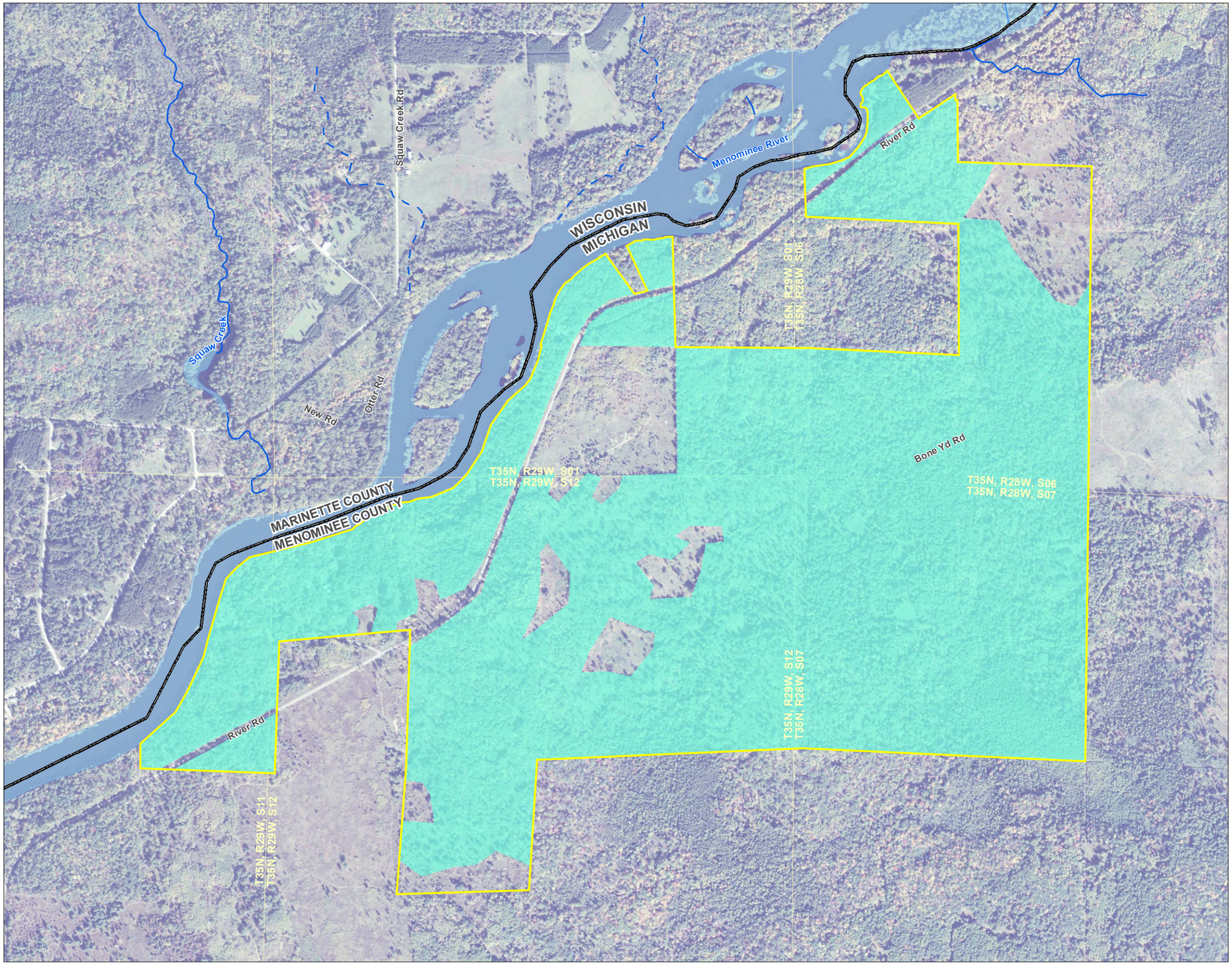


Figure No.
1

Title
Northern Long-eared Bat Habitat Assessment

Client/Project
Aquila Resources Inc.
Foth Infrastructure and Environment
Back Forty Mine

Project Location
T35N, R28W, S06, 07; R29W, S01, 12
Lake Township, Menominee Co., MI

193703271
Prepared by MCP on 2016-06-01
Technical Review by XXX on 2016-XX-XX
Independent Review by XXX on 2016-XX-XX

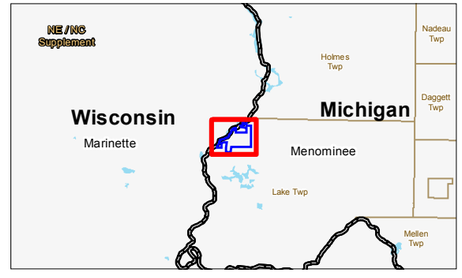
0 500 1,000 Feet

1:12,000 (At original document size of 11x17)

N

Legend
- Project Boundary
- 50+ acres - Medium-Large Roost/Foraging Areas

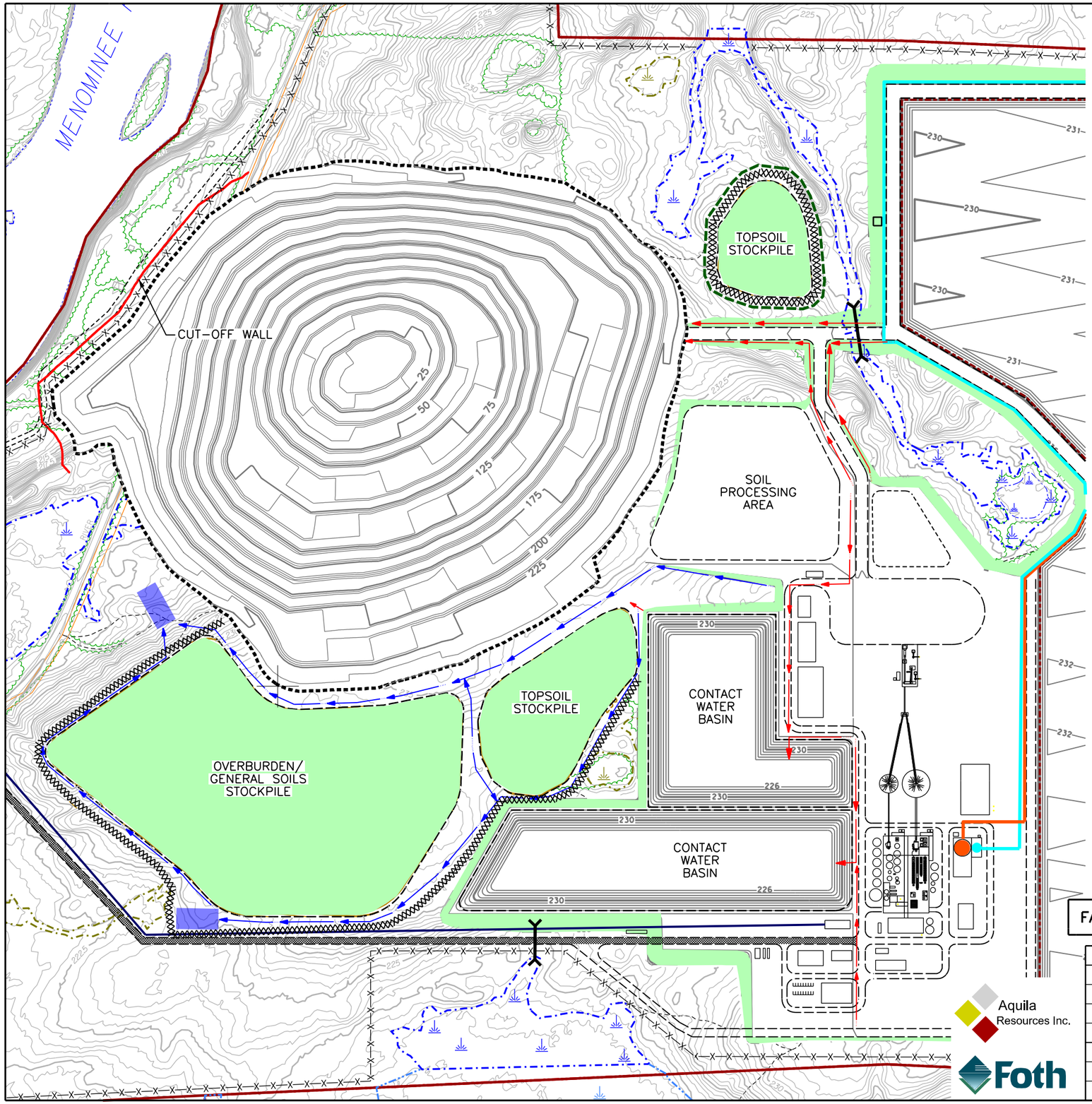
National Hydrography Data
- Perennial Stream
- Intermittent Stream
- Waterbody



Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, USGS, NADS
3. Orthophotography: 2014 NAIP

Stantec

Attachment 108



N

LEGEND

- MINERAL PROPERTY BOUNDARY
- PROJECT BOUNDARY
- EXISTING CONTOUR
- EXISTING BUILDING
- EXISTING ROADWAY
- EXISTING UNIMPROVED ROADWAY
- EXISTING TRAIL
- EXISTING TREE/BRUSH
- EXISTING WATER
- REGULATED WETLAND
- NON-REGULATED WETLAND
- NWI NON-DELINEATED WETLAND
- DESIGNED PIT PERIMETER
- PROPOSED FENCE
- PROPOSED STRUCTURE
- PROPOSED ROADWAY (GRAVEL SURFACE)
- PROPOSED ROADWAY (BITUMINOUS)
- PROPOSED TWRMF LIMITS
- DESIGN CONTOUR
- NON-CONTACT STORMWATER BASIN
- NON-CONTACT WATER DRAINAGE DITCH
- CONTACT WATER DRAINAGE DITCH
- PROPOSED SILT FENCE
- PROPOSED SEEDED AREAS
- PROPOSED GRASS BUFFER STRIP
- PROPOSED CULVERT
- PROPOSED CUT-OFF WALL
- WATER TREATMENT DISCHARGE PIPELINE
- PROPOSED OXIDE TAILINGS PIPELINE
- PROPOSED FLOTATION TAILINGS PIPELINE
- PROPOSED OXIDE TAILINGS THICKENER TANK
- PROPOSED FLOTATION TAILINGS THICKENER TANK

50 0 50 100 150
SCALE 1:5,000 METERS

NOTES:

1. DIGITAL ORTHOPHOTO IMAGERY, TOPOGRAPHIC AND PLANIMETRIC DATA PROVIDED BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE OF ACQUISITION: LIDAR-OCTOBER 31, 2007 AND IMAGERY-MAY 14, 2008.
2. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
3. BACK FORTY PROJECT AREA WITHIN SECTION 1 AND 12, T35N, R29W, LAKE TOWNSHIP, MENOMINEE COUNTY, MICHIGAN.
4. DESIGN BASE GRADES SHOWN FOR TWRMF. REFER TO PHASE DRAWINGS FOR WASTE ROCK GRADING PLAN.
5. FINAL DESIGN EXCAVATION GRADES SHOWN FOR MINE PIT.
6. STOCKPILE GRADES AND SLOPES ARE APPROXIMATE.

FACILITY LAYOUTS SUBJECT TO CHANGE

Aquila Resources Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	JOS1	DATE:	MAY '16
REVIEWED BY:	KKB	DATE:	MAY '16
APPROVED BY:	KKB	DATE:	MAY '16

BACK FORTY PROJECT

FIGURE 108-1

EROSION CONTROL PLAN
OPERATIONS PHASE

Scale:	AS SHOWN	Date:	MAY, 2016
Drafted By:	MRS	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\MDEQ response figures\Figure 108-1 Erosion control plans operations.dgn
6/10/2016 bjw1

Attachment 109

Table 109-1
Mine Facilities Inspection Plan and Schedule

Facility Description	Item	Inspection/Monitoring Actions	Action applicable to: Operation	Inspection Frequency	Postclosure	Inspection Frequency	Remedial Action
TWRMF							
	Perimeter Roads/Culverts	1. Surface conditions - port holes, obstructions and	X	Daily	X	Monthly	1. Grade road and remove obstructions and dispose waste
		2. Perimeter ditches for erosion and siltation.	X	Daily	X	Monthly	2. Reconstruct or remove sediment from ditches.
		3. Road traffic dust generation.	X	Daily	NA	NA	3. Water road and apply dust suppressants.
		4. Signs of cracking or collapse along the road edges.	X	Daily	X	Monthly	4. Complete required repairs.
		5. Road signage.	X	Monthly	NA	NA	5. Repair or replace missing or illegible signs.
	Perimeter Berm and Waste Rock Out Slopes	1. Inspect berms for erosion/displacement.	X	Monthly and after PMP event	X	Monthly and after PMP event	1. Repair eroded areas including revegetated and grading.
		2. Assess berm seeps.	X	Monthly and after PMP event	X	Monthly and after PMP event	2. Provide additional fill material if displacement has occurred.
	Liners, LCS & LDS and SSR	1. Check for leaks in above ground piping and pumps.	X	Monthly	X	Monthly	1. Repair leaks and replace defective components.
		2. Check above ground piping for freezing during winter months.	X	Monthly	X	Monthly	2. Complete service and repairs per manufactures O&M Manual.
		3. Check pressure transduceers in LCS and LDS for proper operation.	X	Monthly	X	Monthly	3. If leakage into the LDS exceeds the calculated rate, report to MDEQ within 24 hours.
		4. Check flow meter and pumps for proper operation.	X	Monthly	NA	NA	4. Complete annual cleaning of LCS and LDS piping and record results in mine records.
		5. Check alarms and alarm lights for proper operation.	X	Monthly	X	Monthly	
		6. Remove liquid from LDS sump and record level and quantity.	X	Monthly	X	Monthly	
		7. Service pumps, trandsducers and glow meters per manufactures's)&M Manual.	X	Monthly	X	Monthly	
Pipelines							
	Tailings Pipeline, Contact Water Pipelines, Slurry Pipelines	1. Inspect pipeline for leaks	X	Once per shift	NA	NA	1. Repair damages or pipeline breach.
		2. inspect leak detection manholes.	X	Once per shift	NA	NA	2. Seal manhole cracks or joints.
							3. Remove solids accumulation in manhole.
Mine Pit							
	Mine Pit Roads and Ramps	1. Surface condition - port holes, obstructions, ore and waste rock spillage.	X	Daily	NA	NA	1. Grade road and remove obstructions and dispose waste rock to TWRMF.
		2. Safety berms have adequate height (axel height of the largest tired vehicle).	X	Weekly	NA	NA	2. Reconstruct berms.
		3. Road traffic dust generation.	X	Daily	NA	NA	3. Water road and apply dust suppressants.
		4. Signs of cracking or collapse along the road edges.	X	Weekly	NA	NA	4. Complete required repairs.
		5. Road camber 2-3% and road grade 10% or less.	X	Weekly	NA	NA	6. Complete required repairs.
	Pit Slope Drainage	1. Properly function horizintal drains	X	Weekly	NA	NA	1. Clean and repair as required.
		2. Groundwater pore-pressure measurement (piezometers) read to determine pore-pressure within the acceptance range.	X	Weekly	NA	NA	2. Reduce pore-pressure by increasing effort of dewatering or install additiomal horizontal drains.

Table 109-1 (*Continued*)

	Pit Slope Stability	1. Slope movements - tension cracks at crest; displacement at toe.	X	Weekly	NA	NA	1. Report to the mine engineer and take appropiate actions immediately.
		2. Water or seepage from slope.	X	Weekly	NA	NA	
		3. Rock fall potnetial - visual inspection of surface displacement, especailly during winter freeze and spring thaw condtions.	X	Daily and more frequently as conditions require	NA	NA	
		4. Geological mapping of pit wall.	X	Daily	NA	NA	1. Report to the mine engineer.
		5. Check dimensions of various componets - bench width, height and slope angle.	X	Weekly	NA	NA	2. Document pit wall construction.
	Overburden Slopes and Vegetation	1. Check erosion, vegetation and signs of instability.	X	Monthly	NA	NA	1. Reseed and provide erosion mat or riprap in eroded areas.
	Ore Blending Area	1. Contact Water sump inspection	X	Monthly	NA	NA	1. Repair/replace sump pump as needed
		2. Imperious surface conditions - concrete pad	X	Monthly	NA	NA	2. Repair as required
Storm Water and Erosion Controls							
	Ditches and Dikes	1. Check for erosion and sediment in ditches.	X	Weekly*	X	Monthly	1. Repair eroded areas and install erosion control measures to remedy erosion.
		2. Check for proper grade alignment.	X	Weekly*	X	Monthly	2. Complete required repairs.
	Culverts	1. Check culverts for damage and debris.	X	Weekly*	X	Monthly	1. Replace rusted or damaged culverts.
	Siltation Fencing	1. Inspect siltation fencing for sediment accumulation and damage.	X	Weekly*	X	Monthly	1. Remove sediment and repair any damage.
	Check Dams	1. Inspect dams for damage.	X	Weekly*	X	Monthly	1. Repair damage to dams.
		2. Inspect dams for siltation.	X	Weekly*	X		2. Remove silt from dams.
	Storm Water Dentention Ponds including CWBs and NCWBs	1. Check influent pipes and effluent structures and ditches for debris.	X	Weekly*	X	Monthly	1. Clean debris from pipes and effluent structures. Replace rusted or damaged piping or effluent structures.
		2. Observe stormwater for signs of surface water pollution.	X	Weekly*	X	Monthly	2. Pump contaminated stormwater to the contact water basin.
		3. Check dead storage (i.e. sediment thickness).	X	Weekly*	X	Monthly	3. Remove sediment if thickness is 1.5 -2.0 feet.
		4. Check vegetation on interior and exterior berms.	X	Weekly*	X	Monthly	4. Reseed and provide erosion mat or riprap in eroded areas.
		5. Check pumps for functionality.	X	Weekly*	X	Monthly	5. Complete required repairs.
		6. Record amount of water pumped to WWTP.	X	Weekly*	X	Monthly	
* Weekly or after a rain event exceeding 1/2 inch in a 24 hour period or following heavy snow melt runoff.							
Surface Infrastructure							
	Roads and Culverts	1. Graded surface with few potholes and free of	X	Monthly	NA	NA	1. Grade road.
		2. No ore or waste rock spillage.	X	Monthly	NA	NA	2. Clean up spillage and dispose of in the TWRMF.
		3. Perimeter ditches for erosion and siltation.	X	Monthly	NA	NA	3. Reconstruct or remove sediment from ditches.
		4. Road traffic dust generation.	X	Monthly	NA	NA	4. Water road and apply dust suppressants.
		5. Signs of cracking or collapse along the road edges.	X	Monthly	NA	NA	5. Complete required repairs.
		6. Road signage.	X	Monthly	NA	NA	6. Repair or replace missing or illegible signs.
	Fire Water System	1. Test for functionality.	X	Monthly	NA	NA	1. Complete required repairs.
	Communication Systems	1. Test for functionality.	X	Monthly	NA	NA	1. Complete required repairs.
	Potable Water Systems	1. Test water quality.	X	Annually	NA	NA	1. Complete required repairs.

Table 109-1 (*Continued*)

	Emergency Response System	1. Test for functionality.	X	Monthly	NA	NA	1. Complete required repairs.
	Areas Restored During Operations	1. Inspect for compliance with erosion and revegetation standards.	X	Monthly	NA	NA	1. Complete required repairs.
	Truck Fueling Station	1. Inspect secondary containment structure, pipes, and pumps for leakage.	X	Monthly	NA	NA	1. Report leaks to MDEQ. Take immediate action to contain spills according to spill plan.
Soil Stockpiles							
	Top soil and other stockpiles	1. Maintain silt fence.	X	Monthly	X	Annually	1. Replace or repair as required.
		2. Maintain othe erosion control devices.	X	Monthly	X	Annually	2. Repair eroded areas including regrading and revegetation.
		3. Inspect for erosion and soil displacement by wind or water.	X	Monthly	X	Annually	3. Clean ditches where silt and/or sand has accumulated.
		4. Inspect vegetation for growth and coverage.	X	Monthly	X	Annually	

Prepared by: RWX

Checked by:JOS

Notes:

% = percent
CWB = Constructed Wetlands Basin
LCS = leachate collection system
LDS = leak detection system
MDEQ = Michigan Department of Environmental Quality
O&M = Operations and Maintenance
SSR = Side Slope Riser
TWRMF = Tailings and Waste Rock Management Facility
WWTP = Wastewater Treatment Plant

Attachment 128

Table 128-1
Reclamation Sequence

Phase	Event	Mine Year
1	Site Construction	-2 to 0
2	Operation	0 to 8
3	Closure Reclamation	8 to 11
4	Postclosure Reclamation	16 to 17

Prepared by: STZ
Checked by: JOS1

Attachment 134

Table 134-1
Inspection and Maintenance of Impervious Surfaces

Observation/Inspection Items	Inspection/Monitoring Actions	Inspection Frequency	Remedial Action
Ore Blending Area (OBA) Concrete Surface	Cracks - indicate types, orientation, width and length, relative location and photographic records	Monthly	Seal cracks and surface. If distress keep repeating notify the Mine Manager and Design Engineer
	Surface conditions - spalling, honeycombs, describe size and photographic records	Monthly	
Bituminous Surface Road	Cracks - indicate types, orientation, width and length, relative location and photographic records	Monthly	
	Surface conditions - pot holes, rutting describe size, relative location and photographic records	Monthly	

Prepared by: RXW
Checked by: JOS

Attachment 135

Plan

Preliminary Quality Assurance Project Plan

Back Forty Project

Project I.D.: 14A021

Aquila Resources Inc.
Stephenson, Michigan

June 2016

Preliminary Quality Assurance Project Plan

Project ID: 14A021

Prepared for

Aquila Resources Inc.

Stephenson, Michigan

Prepared by

Foth Infrastructure & Environment, LLC

June 2016

2121 Innovation Court, Ste. 300 • PO Box 5126 • De Pere, WI 54115-5126 • (920) 497-2500 • Fax: (920) 497-8516 • www.foth.com

Preliminary Quality Assurance Project Plan

Contents

Contents (*continued*)

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Tables

List of Abbreviations, Acronyms, and Symbols

Aquila	Aquila Resources Inc.
CC	continuing calibration
CWB	Contact Water Basins
EPA	Environmental Protection Agency
Foth	Foth Infrastructure & Environment, LLC
N/A	not applicable
ORP	Oxidation Reduction Potential
PM	Project Manager
QA	quality assurance
QAPP Plan	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
S.U.	Standard Units
TWRMF	Tailings and Waste Rock Management Facility

1 Project Description

This *Preliminary Quality Assurance Project Plan (QAPP)* has been developed for the operational and postclosure phases of the Back Forty Project, located in Stephenson, Michigan, in response to Michigan Rule 203 (g)(iii)(B)(ff) and Rule 203 (g)(iii)(D).

The purpose of the *QAPP* is to document how quality assurance (QA) and quality control (QC) are implemented to collect and manage data to assume data is of the appropriate type and quality to support the project quality objectives.

Environmental monitoring during operations will include the following elements:

- Monitoring the groundwater quality and quantity in the vicinity of the Tailings and Waste Rock Management Facility (TWRMF), Mine/Mill Facilities, Contact Water Basins (CWB) and mine;
- Operations water quality monitoring from the mine pit, the Oxide and Flotation TWRMFs, and the CWBs;
- Water quality and elevation monitoring of wetlands in the project area; and
- Surface water quality monitoring and surface water level monitoring on streams and lakes in the vicinity of the Project Area.

Monitoring, with the exception of operations water quality monitoring, will continue during the postclosure phases. The *QAPP* will be updated for other types of monitoring as the needs arise.

2 Organization and Responsibility

This section of the *QAPP* will describe the organization and responsibilities for field operations and laboratory operations.

2.1 Field Operations

Field monitoring and sample collection activities will be performed by personnel from Aquila Resources Inc. (Aquila) or their subcontractors. Field operations will generally consist of sample procurement and ancillary activities, measurement of sample characteristics, sample filtration, sample preservation, sample documentation and recordkeeping, as well as sample shipment to the laboratory for analysis.

2.2 Laboratory Operations

Laboratory analytical activities will be performed by an NLAP-certified laboratory yet to be determined. A copy of the laboratory's MDEQ certification and Quality Assurance Manual will be provided. Aquila will expect the selected laboratory to undertake their analytical activities in accordance with the requirements of their Quality Assurance Manual.

3 Quality Assurance Targets for Precision, Accuracy, and Method Detection Limits

The purpose of QA objectives is to define the precision and accuracy targets as well as the method detection limits which will be used for both laboratory and field measurement data.

All measurements must be made such that results are representative of the media (water, biota, etc.) and conditions being measured. Unless otherwise specified, data will be calculated and reported in consistent units from one sampling event to the next.

Data quality objectives for accuracy and precision for each measurement parameter will be based on the measurement system employed and the requirements of this plan.

4 Sampling Procedures

Sampling procedures for this project are described in this section of the *QAPP*.

4.1 Samples/Measurements

Samples to be collected and/or measurements to be made will be detailed in a forthcoming Sampling and Analysis Plan (SAP) as well as in the Environmental Monitoring Plan included with the Permit to Mine Application. The *QAPP* will be updated as programs are added or discontinued.

4.2 Cleaning/Decontamination Procedures

Sufficient clean equipment should be transported to the field such that field cleaning is minimized. Equipment that is transported to the field shall be pre-cleaned and ready to use.

Equipment is cleaned prior to transportation to the site according to the following scheme:

- Wash with hot water and non-phosphate containing Alconox®.
- Scrub with brush (if necessary).
- Rinse thoroughly with tap water.
- Rinse thoroughly with deionized or distilled water.
- Air dry completely.
- Store in a manner to eliminate the potential for freezing and minimize contamination.

When field decontamination is necessary, the following procedure is to be used:

- Wash thoroughly with non-phosphate containing Alconox® and water using a brush (if necessary) to remove heavy contamination.
- Rinse with water from a documented source.
- Rinse with deionized or distilled water from a documented source.
- Allow equipment to air dry after use.

Records will be maintained which indicate date and method of cleaning. This documentation will be recorded in the field notebook (when equipment is decontaminated in the field) and in the equipment service/maintenance record when cleaning is performed in-house.

4.3 Sampling Containers

Sample containers (when needed) will be provided by the laboratory. The laboratory will provide new containers for samples and shall be able to substantiate the source(s) of containers used on the project.

4.4 Sampling Protocols

Sampling protocols for the *QAPP* are those procedures which will be used to collect those samples specified by the permit and monitoring plan. All field collections will be performed or supervised by Aquila personnel.

4.4.1 Stream and Wetland Sampling

The stream and wetland sampling protocols consist of three subsections:

- Collecting a surface water sampling
- Collecting the field parameters (Specific Conductance, Temperature, pH, and Oxidation Reduction Potential [ORP])
- Collecting stream flow or water level measurements

Site specific sampling protocols for Stream and Wetland samples consist of a collection of field and laboratory parameters. The laboratory water sample is collected first. This assures the sample is clean and no residual contamination could occur from field instrumentation. The field parameters are measured and recorded next using a water quality meter. A Standard Operating Procedure (SOP) will be provided for calibration of the water quality meter and use of the water quality meter (calibration, use, and maintenance). SOPs will be provided in a SAP to be prepared as a condition of the mine permit.

4.4.2 Groundwater Sampling

The groundwater sampling protocols consist of:

- Gauging monitoring well network for water levels.
- Sampling of selected monitoring wells for groundwater.
- Collecting the field parameters (Specific Conductance, Temperature, pH, and ORP).
- Collecting groundwater samples for laboratory analysis.

Site specific sampling protocols for groundwater samples consist of a collection of field and laboratory parameters. The sampling procedure is detailed in Section 4.7.3.

4.5 Sample Documentation/Identification

A sample numbering system is used to identify each sample. This numbering system will assure that each sample is uniquely identified. An SOP for sample identification and labeling will be included with the SAP.

Project sampling activities will be documented by keeping a written record of daily sampling activities using forms provided in this plan for specific activities and/or implementing the chain of custody procedures outlined in Section 5 of this plan. Identification of field duplicates will be kept in the Field Log Book and submitted so the lab cannot determine field duplicate relationships.

4.6 Sample Preservation, Holding Time, Container Types, and Required Sample Volume

Samples requiring refrigeration will be stored in an ice chest containing sufficient wet ice for transport to the laboratory. Samples requiring pH adjustment will be preserved on-site. Preservatives will be provided by the laboratory and shall be of sufficient purity so as not to interfere with the analysis of the parameters of interest. The laboratory shall verify the pH of preserved samples upon receipt.

4.7 Sampling Procedures

Sample collection will be performed or supervised by Aquila personnel.

4.7.1 Stream and Wetland Sampling

Site specific sampling procedures for stream and wetland sampling will be provided in an SOP to be provided with the SAP.

4.7.2 Groundwater Sampling

Site Specific groundwater purging and sampling procedures will be provided in an SOP to be provided with the SAP.

The monitoring well network will first be gauged, then selected monitoring wells in the program will be purged to stabilization before water quality samples are collected. Monitoring wells that were purged dry on the previous day are sampled within 24 hours. Field parameters will be recorded during purging.

4.8 Sample Dispatch

All samples requiring refrigeration will be packed on ice. When packing the shipping containers, precaution will be taken to minimize sample container breakage during transport to the laboratory. An SOP for shipping and packaging of non-hazardous samples will be provided with the SAP.

The chain of custody documentation will be used to track possession of samples on this project. Chain of custody procedures are outlined in Section 5 of this plan. Sample label integrity (i.e., labels will not be allowed to become wet, unreadable) will be ensured.

5 Sample Custody

The chain of custody form supplied by the laboratory will be used to document sample possession from the time the sample bottles leave the sample location until they are received back at the laboratory. An SOP for sample chain of custody will be provided with the SAP to detail the proper procedure for completing chain-of-custodies and also contains a blank chain of custody form. Each time custody of a sample is transferred, the new custodian will sign the form and will document the time and date. A sample will be considered "in custody" if it is:

- in one's actual possession;
- in view, after being in physical possession;
- locked so that no one can tamper with it, after having been in one's physical possession; or
- in a secured area, restrictive to authorized personnel.

Upon receipt of samples in the laboratory, the chain of custody form will be checked and signed. A copy of the form will be retained by the laboratory and the remaining copy returned to the sampling team.

Procedures for preparing and shipping samples will conform to labeling and packing requirements of the United States Department of Transportation, as will be detailed in the SOP for shipping and packaging of non-hazardous samples that will be provided with the SAP.

While awaiting screening or packaging, samples will be stored on wet ice in coolers. Preservatives are added to collected samples such that the physical and/or chemical alterations are minimized. Where preservatives are required, preservatives must be added immediately upon sample collection. The preservative added will be documented on the chain of custody form in the "analyses required" or "remarks" portion of the form. If samples cannot be shipped on the same day that they are collected, packaging will be delayed until the following morning so that the samples can be shipped with a full load of ice. These samples will be stored on wet ice in coolers or in a refrigerator and kept in a secure area.

Each time the custody of the samples is relinquished to another individual (or to the laboratory), the date, time and items transferred are noted on the chain of custody form. After the samples have been packaged for shipping, the custody will be transferred to a team member who will ship or hand deliver the coolers such that the samples are delivered the following day. Upon shipment, the laboratory will be notified that the sample shipment is scheduled to arrive. When wet ice is used, sample bottles and labels will be kept dry and legible.

5.1 Laboratory Arrangement

Aquila will send all samples for analysis to an NLAP-certified laboratory yet to be determined. A copy of the laboratory's MDEQ certification and Quality Assurance Manual will be provided.

5.2 Laboratory Processing of Samples

Procedures for the receipt and logging of samples by the laboratory are addressed in their individual Quality Assurance Manual, which is provided in Appendix A. The following minimum requirements will be expected of any laboratory which is used for sample analysis on a given project.

5.2.1 Receipt of Samples by Laboratory

Upon receipt of samples at the laboratory, the following, at a minimum, shall take place:

Examine all samples and determine if proper temperature has been maintained during shipment. If samples have been damaged during shipment, the remaining samples will be carefully examined to determine whether they were affected. Any samples affected will be considered damaged. It will be noted on the chain of custody form and reported to laboratory management that specific samples were damaged and that the samples were removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged.

- Compare samples received against those listed on the chain of custody and any analysis request forms which may be used. Any discrepancies are to be reported immediately to the Project Manager (PM).
- Verify that sample holding times have not been exceeded.
- Sign and date the chain of custody and any analysis request forms.
- Verify temperature of samples. If the temperature is not within specifications, the PM will be notified so that a decision regarding resampling can be made.
- Verify pH of samples. If the samples have been unpreserved, the PM will be notified so that a decision regarding resampling can be made.
- Assign laboratory number to each sample.
- Place the samples in adequate laboratory cold storage. This is generally accomplished by placing the samples in a refrigerator or cold storage room where the temperature is maintained at 4°C (± 2 degrees C). A maximum-minimum thermometer or thermograph is used to verify temperatures present in the refrigerator or cold room.
- Enter the following information in a laboratory sample log-in system:
  - Assigned laboratory numbers.
  - Project name.
  - Date received in laboratory.
  - Chain of custody number.

5.2.2 Laboratory Storage of Samples

The primary considerations for sample storage are:

- Maintenance of prescribed temperature, if required, which is typically 4°C.
- Proper preservation to ensure integrity of samples until samples are analyzed.
- Security of the laboratory and the samples.

All extraction and chemical analyses of samples at a given project will conform to the holding times. Placement of samples in the proper storage environment is the responsibility of the laboratory.

5.3 Sample Disposal

After the testing program is completed, samples, extracts and digestates are handled, stored and/or disposed in accordance with the individual laboratory's procedure in that regard, and within applicable state and/or federal regulations.

5.4 Documentation

Project sampling activities will be documented by keeping a written record of daily sampling activities and implementing the chain of custody procedures described in this portion of the *QAPP*. The information documented will incorporate that which is specified in Section 5.4.2 of the plan, at a minimum. This will provide for the integrity of data by tracking and documenting samples from the time they are collected by the sampling team through receipt at the laboratory.

5.4.1 Sample Numbering System

A sample numbering system will be used to identify each sample. This numbering system will provide a tracking procedure to allow retrieval of information about a particular sample and assure that each sample is uniquely numbered.

5.4.2 Sample Collection Data

Sample collection data will be collected in the field for each sample acquired. Collection data for samples can be documented on forms adopted for specific activities.

The information to be provided includes that which is required by these forms and any additional information that the field technician deems important.

5.4.3 Sample Labeling

Sample labels must contain sufficient information to uniquely identify the sample in the absence of other documentation. This will include at a minimum:

- Unique sample number which indicates sample location (and depth, if applicable).
- Sampling date and time.
- Company name.
- Grab or composite, filtered or unfiltered.
- Preservation method employed (if any).

5.4.4 Field Log Book

A bound Field Log Book with pre-numbered pages will be used to record field analytical sampling results. The Field Log Book will be completed in indelible ink and will include (as appropriate) a record of:

- Field screening instrument readings.
- Water sampling field parameters (i.e., temperature, specific conductance and pH).
- Sample identification numbers, and time/date of collection, location and description.
- Sample preservation documentation.
- Instrument adjustments (calibrations) performed in the field.
- Statements pertaining to any problems encountered.
- Field analysts.
- Weather/site conditions.
- Individuals collecting samples and field supervisor's signature.
- Note any other information relevant to the sampling including presence and characteristics of suspended matter, bubbling, and gas exchange, etc.).

Mistakes in the Field Log Book will be crossed through with a single line, initialed, and dated.

5.4.5 Common Carrier Shipments

Samples which are not hand delivered may be shipped to the laboratory using common carriers. A copy of the shipping documents which are completed in order to ship samples with a carrier will be maintained as part of the file in order to demonstrate sample custody.

6 Analytical Methods

The field reading methodologies to be taken or analytical methods to be performed will be specified in the SAP, which will be prepared prior to the initiation of site construction activities.

7 Calibration Procedures and Frequency

Standardized calibration of the equipment used is necessary to obtain valid data.

Measuring and test equipment will be calibrated at prescribed intervals and/or prior to each use. The frequency of calibration will be based on the type of equipment, relative stability, manufacturer's recommendation, intended use and experience with a particular piece of equipment. Calibration procedures and frequency of calibration of field equipment that will be used will be provided in an SOP for calibration frequency and procedures to be included with the SAP.

Replicate field measurements of samples and laboratory analysis of replicate samples will be performed to document the effectiveness of these calibration procedures.

Calibration records for equipment used will be maintained.

Field instrument calibration procedures are summarized in Table 7-1. Standards used in calibration procedures will be purchased as certified solutions (Table 7-2). The standards which are used and/or any preparation of standards by field personnel will be documented. The documentation will contain the following information for equipment used:

- Date of calibration.
- Lot numbers for standards.
- Manufacturer of standards.
- Date of expiration of standards.
- Temperature of standards.
- Data pertaining to calibration and/or maintenance procedures.
- An indication of the person performing the calibration and/or maintenance.
- Adjustments made and an indication of accuracy of the equipment readings prior to and following such adjustments (where applicable).
- Records of equipment failure or inability to calibrate to specification (where applicable).

Lab equipment procedures used are detailed in Section 5 of Appendix A and the analytical SOPs.

Table 7-1

Field Instrument Calibration

Instrument*	Number of Standards Initial Calibration	Acceptance/ Rejection Criteria (Initial)	Frequency	Number of Standards Continual Calibration	Acceptance/ Rejection Criteria (Continuing)	Frequency
pH Meter	3	±0.1S.U.	Daily prior to use or failure of continuing calibration.	1	Reading within 5% of known value.	Initial and every ten samples.
Conductivity Meter	1	±1%	Daily prior to use or failure of continuing calibration.	1	Reading within 5% of known value.	Initial and every ten samples.
ORP	1	±10mV	Daily prior to use or failure of continuing calibration.	1	Reading within 5% of known value.	Initial and every ten samples.
Thermometer	N/A	±0.1°C	Yearly	N/A	N/A	N/A

*Specific calibrations are completed per manufacturer and are instrument and parameter specific.
N/A – not applicable
S.U. – Standard Unit

Prepared by: NMG1
Checked by: SVF

Table 7-2

Standard Sources and Preparation

Instrument Group	Standard Source	How Received	Source Storage	Preparation From Source	Preparation Frequency
pH Meter	Commercial Lab Supplier	Certified Solutions	Room Temp.	N/A	N/A
Conductivity	Commercial Lab Supplier	Certified Solutions or Standard	Room Temp.	N/A	N/A

N/A – not applicable

Prepared by: NMG1
Checked by: SVF

8 Preventative Maintenance

The result of any equipment/instrument readings depends on the inherent accuracy and proper operation, use and function of the instrument. It is essential that the equipment/instruments operate under optimum conditions at all times. Each equipment/instrument user is expected to be familiar with the manufacturer's operations manual on each instrument and routinely performs various service checks.

Each equipment/instrument is calibrated according to the manufacturer's instructions. A maintenance log will be maintained for each instrument. This maintenance log will include the following (at a minimum):

- Instrument description.
- Manufacturer, model number and serial number.
- Name, address and telephone number of company which services item.
- Type of service policy.
- Timing and frequency of routine maintenance, servicing and calibration.

Routine field preventive maintenance procedures are found in Table 8-1.

Table 8-1

Field Preventative Maintenance

Instrument	Activity	Frequency
pH Meter	Rinse electrodes with deionized or distilled water	After each reading
	Immerse electrodes if required to do so based on type of electrode	When not in use
	Clean electrodes with mild acid or alcohol solution	When dirty, coated with oil or other precipitate or, when sensor probe will not calibrate to pH 10 or pH 4 solutions
	Check batteries	Before each use
Conductivity Meter	Standardization with standard potassium chloride solution	Prior to each use
	Rinse probe with deionized or distilled water	After each use
	Check batteries (if any)	Prior to each use
ORP Meter	Rinse electrodes with deionized or distilled water	After each reading
	Check batteries (if any)	Prior to each use

Prepared by: NMG1
Checked by: SVF

8.1 Field Preventative Maintenance

1. Attempts made by field technician to correct the problem immediately, by referencing available service information. Samples are returned to proper storage during trouble-shooting.

2. Management is appraised that an equipment malfunction is disrupting normal field sampling activities. Attempts made to correct failure are described.

3. Management decides whether or not to involve outside servicing. This decision is based on the nature of the problem and availability of service assistance and parts.

4. Management assesses time required to restore proper equipment function in relation to remaining sample-holding time.

5. Management selects an approved alternate analytical method, if possible, which will permit completion of field activities within applicable time limits (if any).

6. Management makes arrangements with another equipment source to complete the field measurements within remaining holding time and by approved methodology.

Recommended field corrective actions are found in Table 8-2.

Table 8-2

Recommended Field Corrective Action

QC Activity	Acceptance Criteria	Recommended Corrective Action
Instrument Zero	Must Zero	Reset zero: if same response, determine cause.
Initial Calibration	Standard concentration ±5% of expected value	Reanalyze standards; if still unacceptable, remake standards. If equipment malfunctions, notify manager.
QC Check Standard	±5% of expected value	Reanalyze standard; if still unacceptable, remake standards or use new standards. If equipment malfunctions, notify manager.
Continuing Calibration (CC)	±5% of expected values	Reanalyze standard; if unacceptable, recalibrate equipment and rerun samples from last CC standard check. If equipment malfunctions, notify manager.

Prepared by: NMG1
Checked by: SVF

8.2 Documentation

Routine maintenance procedures will be documented and records of maintenance activities will be kept for each instrument. Records of non-routine repairs will be maintained as well.

9 Quality Control Checks

The QC checks described in this section are those to be used in conjunction with those sampling events.

9.1 Field Quality Control Checks

9.1.1 Sampling Events Involving Ten or More Samples of Common Matrix

9.1.1.1 Equipment Blank

At least one equipment blank on clean sampling equipment will be submitted and analyzed for every 20 samples in a matrix group. This blank will be prepared in the field before sampling begins by filling or rinsing the pre-cleaned equipment with analyte-free water, filling the appropriate container(s) and preserving and documenting in the same manner as the collected samples. Suitable blanks for analyte groups of interest will be submitted and analyzed for each type of equipment set to be used in sampling. Dedicated equipment shall be used in all cases for sample locations. However, the field blank will serve as an indicator of potential field contaminants under normal field conditions.

9.1.1.2 Field Duplicates

During each independent sampling event, at least one sample, or 10% of the samples, whichever is greater, will be collected in duplicate for analysis. This requirement applies to each matrix group that is sampled.

9.1.2 Sampling Events Involving Five to Ten Samples of Common Matrix

9.1.2.1 Equipment Blank

If equipment is cleaned in the field, one equipment blank for each matrix group will be collected and analyzed on the field-decontaminated equipment. If no equipment is cleaned, then one equipment blank that is prepared on-site on the pre-cleaned equipment will be collected and analyzed for each matrix group.

9.1.2.2 Field Duplicates

One field duplicate will be collected and analyzed for all matrix groups.

9.1.3 Sampling Events Involving Less than Five Samples of Common Matrix

9.1.3.1 Equipment Blank

One equipment blank on either pre-cleaned or field-decontaminated equipment will be collected and analyzed for each matrix group.

9.1.3.2 Field Duplicates

One field duplicate will be collected and analyzed for all matrix groups.

9.2 Laboratory Quality Control Checks

The selected laboratory will use method blanks, matrix spikes and QC check standards.

9.3 Routine Procedures to Assess Precision and Accuracy

The results of the instrument readings or laboratory internal QC checks (as appropriate) will be used to evaluate precision and accuracy.

9.3.1 Evaluation of Field Analytical Precision

To determine the precision of the field sampling methods used, a routine program of duplicate measurements/analyses will be performed. The results of duplicate measurements/analyses will be used to calculate the relative percent difference (RPD) to assess the degree of precision associated with field measurement systems. Field duplicates will be coded blind to the laboratory during routine sample submittals.

The RPD is defined as: $$\%RPD = D_1 - D_2 \Big/ \left(\frac{D_1 + D_2}{2} \right) \times 100\%$$

where: RPD = relative percent difference
D_1 = first sample value
D_2 = second sample value

Acceptable ranges for field measurements are dependent on the equipment used.

9.3.2 Evaluation of Laboratory Analytical Precision

The laboratory will use quality assurance procedures to ensure analytical precision and accuracy.

10 Data Reduction, Validation, and Reporting

10.1 Data Reduction

The field technician will be responsible for reading charts and/or interpreting instrument output and raw concentration data. Field measurement data will be entered into spreadsheets for tabulation and analysis. Data entry will be performed by the analyst, technicians or managers. It will be the responsibility of the manager to ensure that data are entered accurately and on time.

10.2 Data Validation

10.2.1 Data Integrity

Technicians and ultimately, PMs, will be responsible for the following tasks associated with checking data integrity:

- Checking raw data entries and calculations.
- Checking sample preparation log books.
- Checking analytical log books.
- Checking calibration integrity.
- Checking internal chain of custody.
- Checking field sample log book and analytical report sample ID agreement.

10.2.2 Review and Verification

An SOP for data verification, validation, and qualification will be provided with the SAP to provide detailed site specific procedures for data validation.

10.2.2.1 Field Activities

It will be the responsibility of the field technician to properly perform routine QC checks and to identify and report out of control situations. These will be internal checks conducted by the field technician prior to data having sent to Aquila's Quality Manager. The Quality Manager will be responsible for verification of QC checks and resolution of any out of control situations.

10.2.2.2 Project Data

The Quality Manager will be responsible for reviewing overall project data before submission. Key areas of review include field QC data, review of supporting documentation, and review of data for any obvious anomalous values.

10.3 Data Storage

Raw and processed data will be stored on computer drives and/or secure servers. Computer files will be backed-up on separate disks stored in a different location than the original files. Field, laboratory, sample preparation and analytical log books will also be stored. All archived data will be stored in such a manner that records are easily accessed. All records will be maintained for a minimum of three years or longer as warranted by the project. An SOP for the process of managing environmental data will be provided with the SAP.

10.4 Data Reporting

Data entry will be performed by the analyst or project technician. The Quality Manager will be responsible for checking data entry. The Quality Manager will assure that data on the final report are correct by performing an informal audit of analytical, data entry, and data reduction procedures.

Aquila will submit data resulting from the stipulation monitoring, as described in this *QAPP*, within 45 days of receipt of a final lab report.

A hard copy transmittal letter and summary of missing data will be included with the data. The letter will contain Aquila's explanation relating to any missing data.

11 Corrective Actions

A nonconformance is any procedure, event, reading or measurement which is outside the limits established for field operations.

As a result of a nonconformance, whether identified by the Quality Manager, the sampling technician, or by an auditor, a corrective action shall be implemented. Any one of the individuals indicated above can initiate a corrective action, if necessary.

Corrective actions are generally of two kinds:

- Immediate, to recalibrate or repair nonconforming equipment. The need for such an action will most frequently be identified by the field technician.

- Long-term, to eliminate causes of nonconformance and to minimize the possibility of their recurrence. These are usually system-related issues that may be identified as the result of QC reports associated with one or more projects.

Field corrective action procedures are detailed in Table 8-2.

Depending on the nature of the problem, the corrective action employed may be formal or informal. An informal corrective action consists of an evaluation of a nonconforming situation that threatens the outcome of a procedure, event, reading or measurement. Upon recognition of the problem, the field technician will review his/her procedure for apparent errors, recalibrate the instrument used for measurement and re-measure.

If this does not result in correction of the problem, the field technician will bring the problem to the attention of the appropriate manager who will determine the proper corrective action. If significant time or costs are involved, the manager will obtain the necessary approval for the corrective action indicated. The corrective action will be incorporated into the appropriate procedures to minimize the possibility of recurrence.

In either case, occurrence of the problem; corrective action taken; and verification of problem resolution must be documented. Documentation of corrective action will be made in the Field Log Book.

Laboratory corrective actions will be the responsibility of the selected laboratory.

12 Performance and System Audits

12.1 System Audits

A systems audit determines that each element within an activity is functioning appropriately and is within the guidelines specified by the *QAPP*. These types of audits may be conducted on field sampling, preservation, shipping and equipment calibration/cleaning procedures. A systems audit will include a review of the Sampling and Analysis Plan, sample collection/measurement methods, sampling protocol, field chain of custody procedures, field documentation methods, and sample identification methods.

12.2 Performance Audits

These types of audits may be conducted on field or laboratory activities. Aquila reserves the right to audit laboratories used for analyses on a regular basis or if there are inappropriate trends in the laboratory data, major changes in personnel, and/or discrepancies in QC samples.

Laboratory quality system audits and reviews will be the responsibility of the selected laboratory.

13 Quality Assurance Records

Records shall be maintained to provide evidence of QA activities. All activities which indicate an out of control situation will be evaluated. Corrective actions taken will be documented. This documentation will be in the field records or in formal memos, letters or notifications which are part of the file.

Records will be maintained for a minimum period of three years or as specified by permit or regulation.

14 References

Michigan Department of Environmental Quality, 2004. *Sampling and Analysis-Attachment 1 Target Detection Limits and Designated Analytical Methods*. RRD Operational Memorandum No. 2.

United States Environmental Protection Agency, 1983. Methods for Chemical Analysis of Water and Wastes EPA 600/4-79-020. Revised March 1983.

Attachment 143

Memorandum

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June 1, 2016

TO: Steve Donohue, Foth Infrastructure & Environment, LLC
Kris Baran, Foth Infrastructure & Environment, LLC

CC: Master File 14A021/6000

FR: Dave Donohue, Foth Infrastructure & Environment, LLC
Nick Azzolina, Foth Infrastructure & Environment, LLC

RE: Flood Frequency Analysis

The MPA included an assessment of the 100-year flood magnitude and associated flood stage elevation relative to Menominee River bank elevations in the Project Area. That analysis demonstrated that the 100-year event on the Menominee River poses no inundation threat to mine facilities. The 100-year event is the commonly-used design event for infrastructure risk evaluations and survivability design standards.

To further evaluate flood risk and consequences associated with the Aquila Project, and to respond to MDEQ request for additional risk evaluation related to Menominee River Flooding, a more detailed flood risk analysis was performed. That analysis and its results are presented here.

1 Technical Approach

The technical approach includes three steps:

- Step 1 – Conduct a flood-frequency analysis of the Menominee River near the Back Forty Project Area to calculate the probability of exceeding a specified river discharge magnitude;

- Step 2 – Establish the elevation of the Menominee River near the Back Forty Project Area in response to a specified river discharge magnitude to assess the river discharge magnitude that is required to inundate the Back Forty Project Area; and

- Step 3 – Calculate the risk, defined as the probability that one or more events will exceed a given flood magnitude within a specified period of years.

2 Flood Frequency Analysis

The analysis combined a statistical analysis of flood discharges at selected recurrence intervals with the flood-frequency analysis of the Menominee River developed by Walker and Krug (2003) to assess the flood-frequency of the Menominee River near the Back Forty Project Area.

The technical approach does not account for control structures on the Menominee River (i.e., dams and reservoirs), which would act to regulate river discharge and therefore reduce the likelihood of peak flow events exceeding flood stage. Therefore, the technical approach presented here is conservative in that it assumes river discharges during extreme precipitation events would progress unimpeded by control structures, i.e., as if the Menominee River did not have control structures to regulate flow.

2.1 Data Sources

Data were collected for peak streamflow discharge (Peak Q) from the U.S. Geological Survey (USGS) for two different stations:

- (USGS 04066030) Menominee River at White Rapids Dam near Banat, Michigan (approximately 1.8 miles upriver from the Back Forty Project Area) and

(USGS 04066800) Menominee River at Koss, Michigan (approximately 22 miles downriver from the Back Forty Project Area).

2.2 Log-Pearson Type III Distribution

Peak flow data were fit to a log-Pearson Type III distribution using the methods described in Interagency Advisory Committee on Water Data (IACWG, 1982). All calculations were done in Microsoft Excel®. A detailed description of these statistical methods may be found in IACWG (1982); a brief summary of the approach is described below.

The Log-Pearson Type III distribution is calculated using the general equation:

$$\log(X) = \overline{\log(X)} + K\sigma_{\log(X)} \qquad \text{[Eq. 1]}$$

Where X is the flood discharge value of some specified probability, $\overline{\log(X)}$ is the average of the log(X) discharge values, K is a frequency factor, and $\sigma_{\log(X)}$ is the standard deviation of the log(X) values. The frequency factor K is a function of the skewness coefficient and return period and can be found using the frequency factor table in Appendix 3 of IACWG (1982). The flood magnitudes for the various return periods are found by solving Eq. 1.

The flood discharge at recurrence intervals of 2, 5, 10, 25, 50, 100, and 200 years was then evaluated. The period of record and discharge for the indicated recurrence interval are shown for both USGS stations in Table 1. Curves illustrating the log-Pearson Type III distribution for both USGS stations are shown in Figure 1 (top panels).

The exceedance probability for a given discharge is the reciprocal of the return period, which is defined as (n+1) / m, where n is the number of USGS station measurements and m is the Peak flow rank. The probability of exceedance was fitted to a lognormal distribution (red line in Figure 1, bottom panels), which can then be used to calculate the exceedance probability of any discharge magnitude.

Together, the log-Pearson Type III distribution and the exceedance probability curves provide information about the likelihood of exceeding a river discharge of a given magnitude.

The 100-year recurrence interval discharges for the White Rapids Dam and Koss USGS stations are 24,729 and 29,827, respectively. The 200-year recurrence interval discharges for the White Rapids Dam and Koss stations are 27,518 and 32,227, respectively.

Based on these findings, the data from the USGS station 04066800 (Menominee River at Koss, MI) were selected for further analysis. This gage has the greater period of record (84 years versus 17 years) and the higher 100-year discharge (29,821 versus 24,729) (Table 1). In addition, USGS station 04066800 was included in Walker and Krug (2003), which allows direct comparison to the flood-frequency results from that USGS study.

Table 1. Period of record and estimated discharge for the indicated recurrence intervals for USGS stations 04066030 (Menominee River at White Rapids Dam near Banat, Michigan) and 04066800 (Menominee River at Koss, Michigan).

Station ID	Period of Record	Number of Years	Discharge for the Indicated Recurrence Interval (cfs)						
			2	5	10	25	50	100	200
04066030	1999-2015	17	9,865	13,537	16,089	19,451	22,045	24,729	27,518
04066800	1908-2015	84	12,909	17,903	21,004	24,706	27,326	29,821	32,227

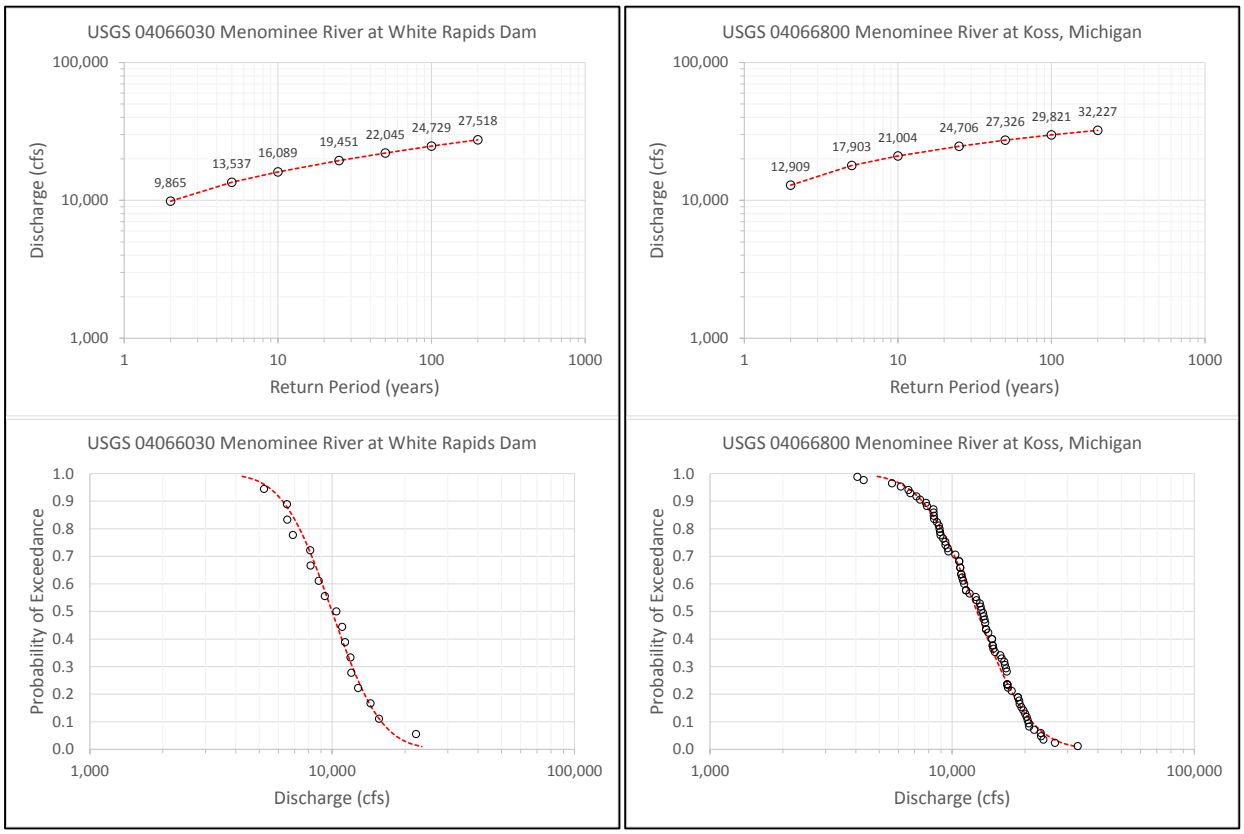


Figure 1. Flood-frequency analysis results using log-Pearson Type III distribution for USGS stations 04066030 (Menominee River at White Rapids Dam near Banat, Michigan) [left column] and 04066800 (Menominee River at Koss, Michigan) [right column]. The top panels show the predicted discharge for a given return period. In the top panels, the black circles correspond to the data presented in Table 1 from the log-Pearson Type III distribution and the red lines connect return periods from 2 to 200 years. The bottom panels show the exceedance probability for a discharge of a given size. In the bottom panels, the black circles are Peak Q measurements from the USGS station and the red lines are fitted lognormal distributions.

Table 2 compares our flood-frequency results to those presented by Walker and Krug (2003). Our analysis compares well to their results, especially for the 100-year event. For example, in Table A-1 Walker and Krug (2003) report a 100-year discharge of 29,800 cfs, which is identical to our estimate of 29,831 cfs when rounded to three significant digits. Small differences are to be expected because this analysis includes water years 2003 through 2015, which were not included in the Walker and Krug (2003) study.[1] Walker and Krug (2003) do not report a 200-year discharge, which is why this study included an independent analysis to permit extensions to recurrence intervals beyond 100 years.

Table 2. Discharge for the indicated recurrence intervals for USGS station 04066800 (Menominee River at Koss, Michigan) as reported by Walker and Krug (2003) and Foth.

Station ID	Analysis	Discharge for the Indicated Recurrence Interval (cfs)						
		2	5	10	25	50	100	200
04066800	Walker and Krug (2003)	13,200	18,400	21,500	25,100	27,500	29,800	NA
04066800	Foth (this document)	12,909	17,903	21,004	24,706	27,326	29,821	32,227

3 Menominee River Elevation-Discharge Relationships

The analysis indicated that the 100-year flood elevation in the vicinity of the Back Forty Project Area is 211.7 meters, which was rounded up to 212 meters in the MPA to ensure a conservative floodplain delineation.[2] This value was taken from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) and confirmed using the Manning Equation for open-channel flow (Manning, 1891):

$$Q = \frac{C_m}{n}\left(A\left(\frac{A}{WP}\right)^{\frac{2}{3}} S^{\frac{1}{2}}\right) \qquad \text{[Eq. 2]}$$

Where:

- Q = discharge (m^3/s)
- C_m = 1 (unit conversion, dimensionless for SI units)
- n = roughness factor (dimensionless)
- A = cross-sectional area of flow (m^2)
- WP = wetted perimeter (m)
- S = channel slope (dimensionless)

[1] The flood- frequency estimates presented in Walker and Krug (2003) were based on the common logarithms of discharge. The flood-frequency estimates in Appendix Tables A-1 (log-Pearson Type III) and A-2 (multiple regression using discharge-basin characteristics) are essentially independent and, therefore, could be combined to get an improved estimate at each site. However, there are no Table A-2 discharge-basin characteristics for the Menominee River. Therefore, we use only the log-Pearson Type III estimates in this analysis.

[2] August 7, 2015, memorandum from Dave Donohue (Foth) to Andrew Boushy (Aquila Resources, Inc.) entitled, "100-Year Floodplain Delineation".

If *Q*, *n*, and *S* are known and the cross-sectional geometry of the channel is known (i.e., the relationship between the cross-sectional area [*A*] and wetted perimeter [*WP*]), then Eq. 2 can be solved for depth of flood stage. We use $n = 0.045$ and $S = 0.000204$, which are based on previous Foth analyses.[3] The relationships for *A* and *WP* were obtained from digital terrain models created in AutoCAD using 0.5-m contour data obtained from aerial surveying of the Back Forty Project Area. Figure 2 shows the locations of five cross-sections that were drawn along the Menominee River adjacent to the Back Forty Project Area. Figures 3 and 4 show cross-sections 3 and 4, respectively, which were determined to be the reaches adjacent to the Back Forty Project Area with the lowest elevation of existing grade. Cross-sections 3 and 4 show the corresponding *A* and *WP* values which were used for the Eq. 2 calculations.

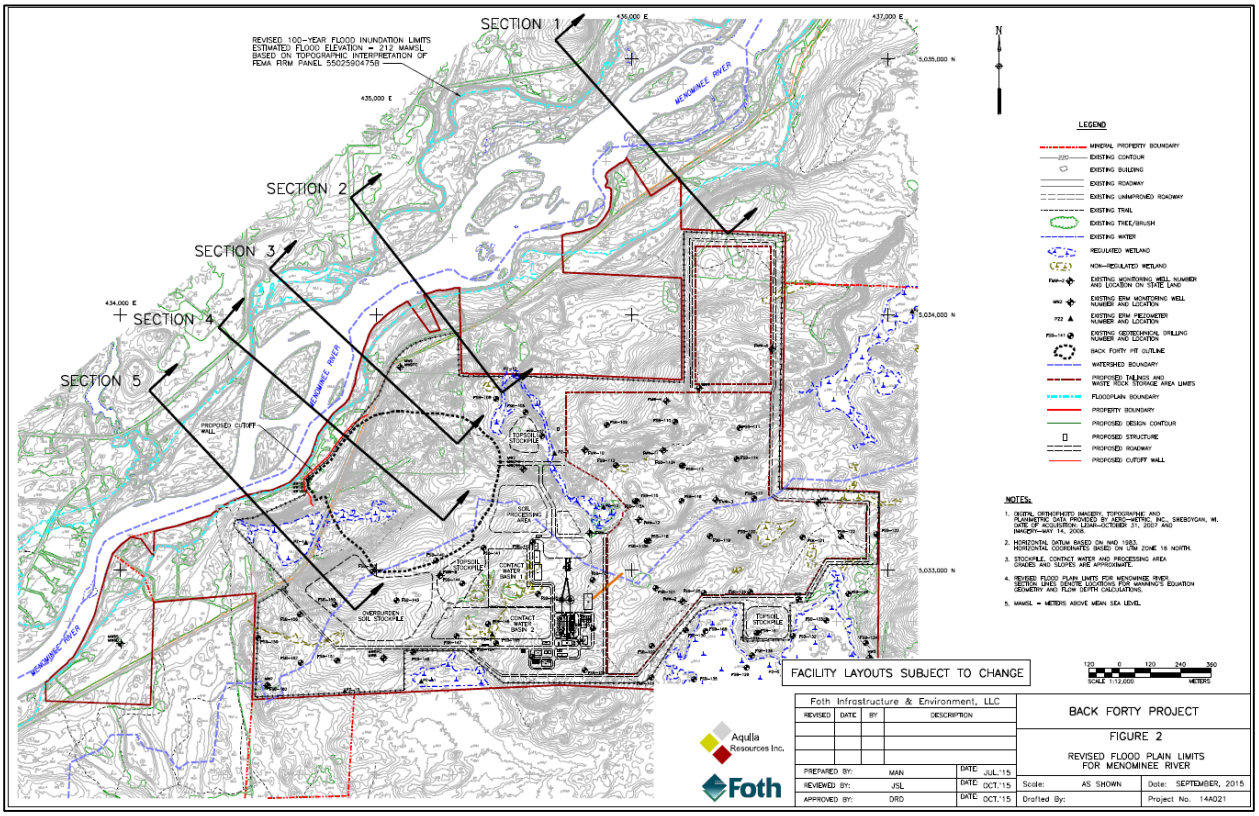
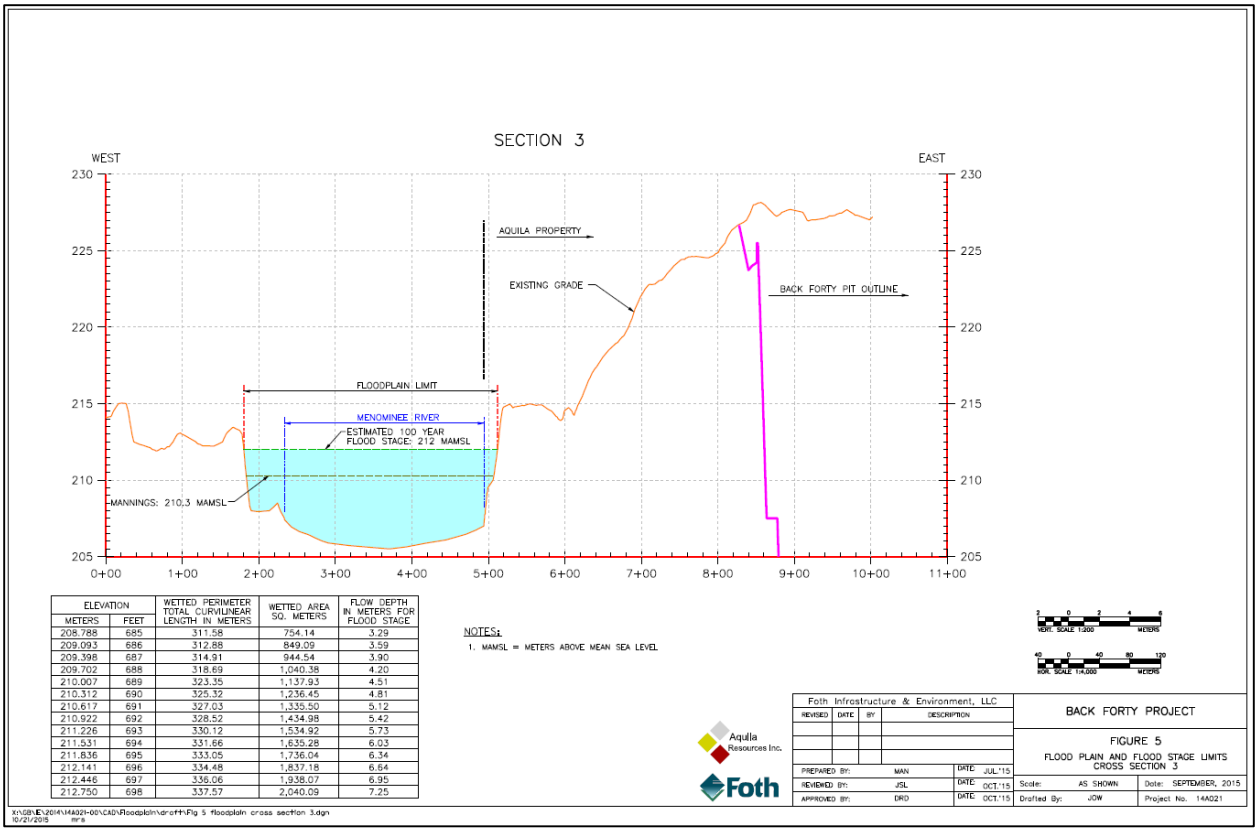


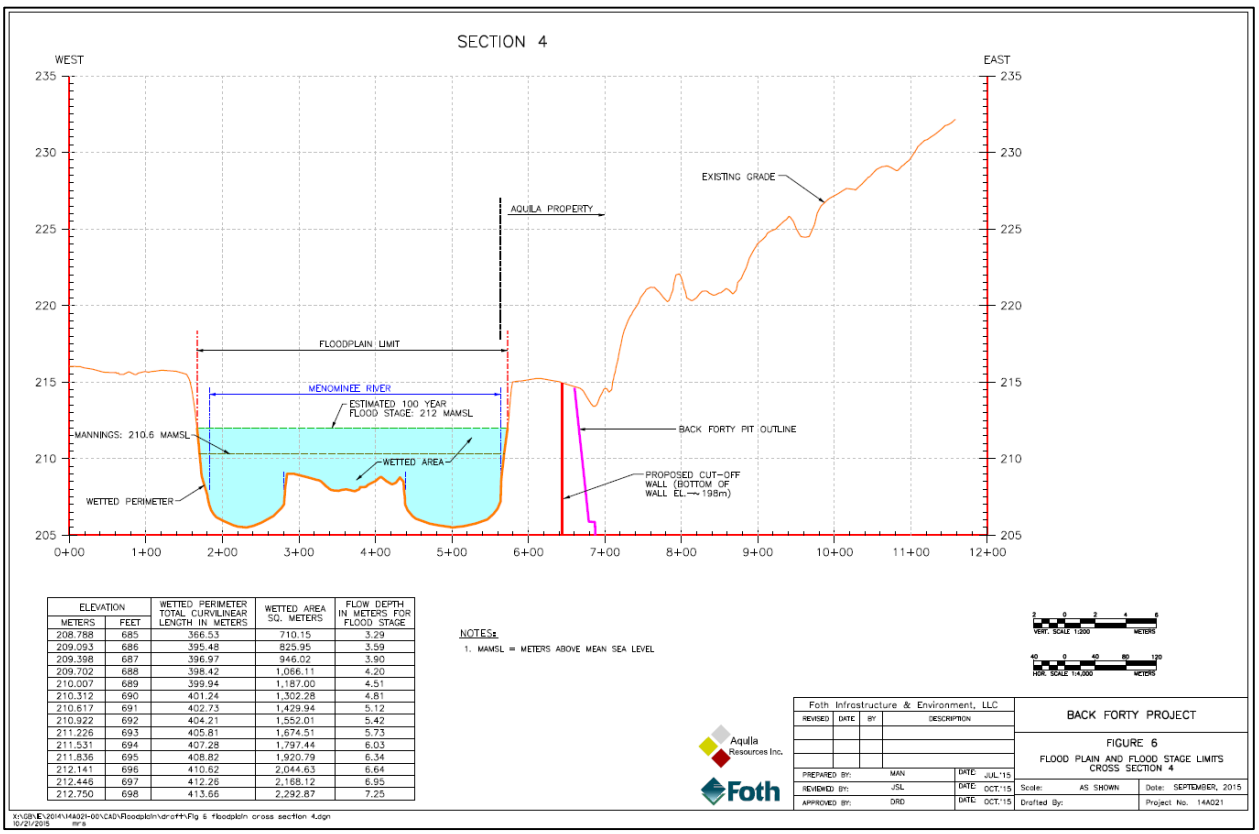
Figure 2. Locations of five cross-sections along the Back Forty Project Area that were used to solve the Manning Equation (Eq. 2) for depth of flood stage.

[3] *Ibid*.



ELEVATION		WETTED PERIMETER TOTAL CURVILINEAR LENGTH IN METERS	WETTED AREA SQ. METERS	FLOW DEPTH IN METERS FOR FLOOD STAGE
METERS	FEET			
208.788	685	311.58	754.14	3.29
209.093	686	312.88	849.09	3.59
209.398	687	314.91	944.54	3.90
209.702	688	318.69	1,040.38	4.20
210.007	689	323.35	1,137.93	4.51
210.312	690	325.32	1,236.45	4.81
210.617	691	327.03	1,335.50	5.12
210.922	692	328.52	1,434.98	5.42
211.226	693	330.12	1,534.92	5.73
211.531	694	331.66	1,635.28	6.03
211.836	695	333.05	1,736.04	6.34
212.141	696	334.48	1,837.18	6.64
212.446	697	336.06	1,938.07	6.95
212.750	698	337.57	2,040.09	7.25

Figure 3. Flood plain and flood stage limits for cross-section 3.



ELEVATION		WETTED PERIMETER TOTAL CURVILINEAR LENGTH IN METERS	WETTED AREA SQ. METERS	FLOW DEPTH IN METERS FOR FLOOD STAGE
METERS	FEET			
208.788	685	366.53	710.15	3.29
209.093	686	395.48	825.95	3.59
209.398	687	396.97	946.02	3.90
209.702	688	398.42	1,066.11	4.20
210.007	689	399.94	1,187.00	4.51
210.312	690	401.24	1,302.28	4.81
210.617	691	402.73	1,429.94	5.12
210.922	692	404.21	1,552.01	5.42
211.226	693	405.81	1,674.51	5.73
211.531	694	407.28	1,797.44	6.03
211.836	695	408.82	1,920.79	6.34
212.141	696	410.62	2,044.63	6.64
212.446	697	412.26	2,168.12	6.95
212.750	698	413.66	2,292.87	7.25

Figure 4. Flood plain and flood stage limits for cross-section 4.

Figure 5 (top panel) shows the Menominee River elevation for a given discharge magnitude for cross-sections 3 and 4 using the previously stated inputs. In the bottom panel of Figure 5, the discharge magnitudes have been translated to recurrence intervals in years.

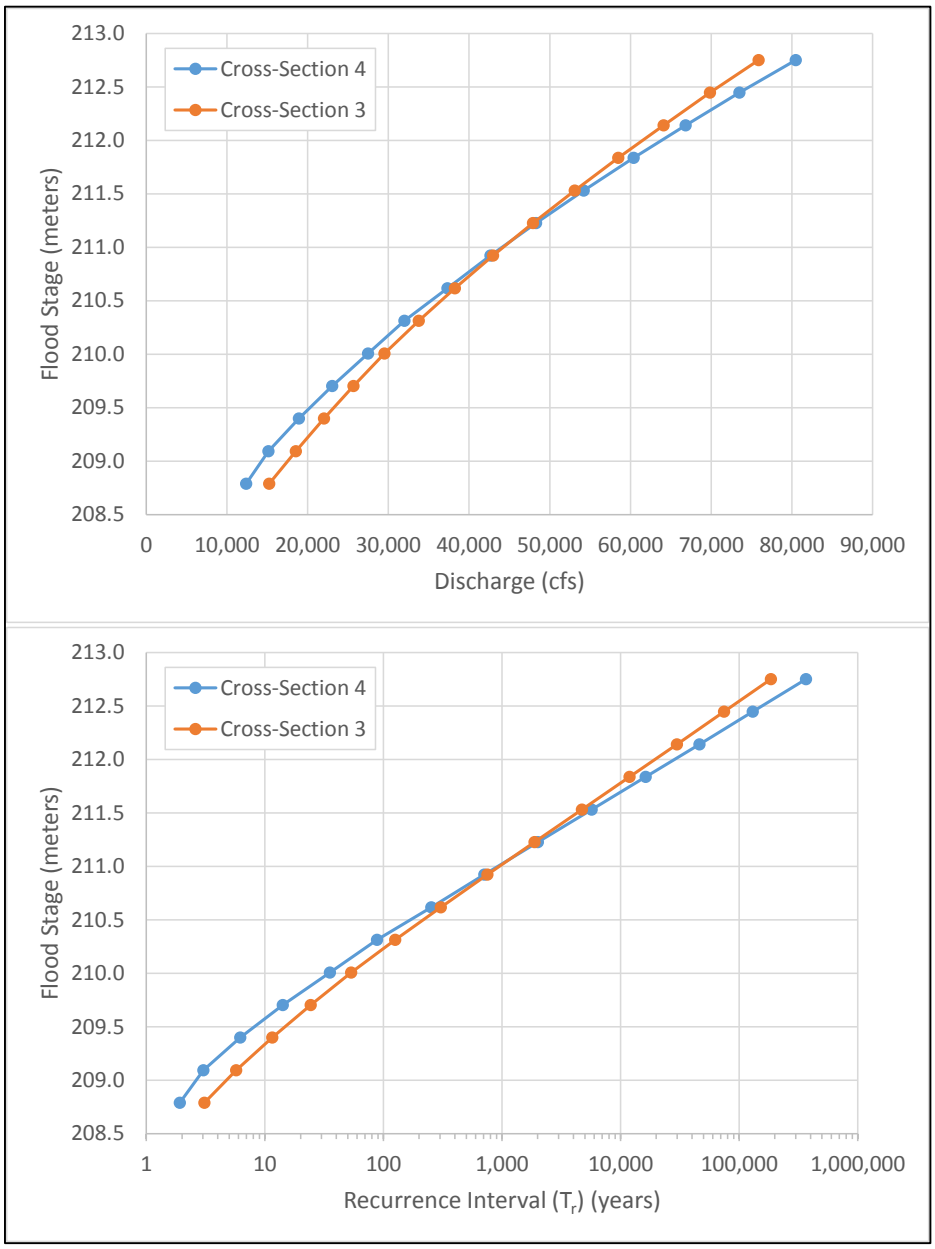


Figure 5. Results of Manning Equation calculations (Eq. 2) for cross-sections 3 and 4. The top panel shows flood stage in meters as a function of Menominee River discharge in cubic feet per second. The bottom panel also shows flood stage in meters, but the *x*-axis has been translated to show the recurrence interval of the Menominee River discharge.

Based on the Manning Equation results in Figure 5, the 100-year flood stage at cross-sections 3 and 4 correspond to elevations of 210.3 and 210.4 m, respectively. The minimum elevation of existing river banks that must be exceeded to inundate the Project Area at any of the three cross-sections is approximately 215 m. The Menominee River discharge required to achieve this flood stage is well in excess of 80,000 cfs. This event magnitude translates into a recurrence interval in excess of 100,000 years.

4 Flood Risk Analysis

As described in Appendix 10 of IACWG (1982), this analysis uses the binomial expression for estimating the risk incurred when a location is occupied for a period of years. For the Back Forty Project, an assumed duration of 50 years for mine operations, reclamation, and post closure was assumed (50 years was chosen as a conservatively long estimate for the duration of operations, reclamation and post-closure monitoring). Using the methodology provided in IACWG (1982) the risk was defined as the probability that one or more events will exceed a given flood magnitude within a specified period of years.

The binomial expression for estimating risk is:

$$R_I = \frac{N!}{I!\,(N-I)!} P^I (1-P)^{N-I}$$

[Eq. 3]

Where R_I is the estimated risk of obtaining in N years exactly I number of flood events exceeding a flood magnitude with annual exceedance probability P. When I equals 0, Eq. 3 reduces to (IACWG, 1982):

$$R_0 = (1-P)^N$$

[Eq. 4]

Where R_0 is the estimated risk of non-exceedance of the selected flood magnitude in N years. The risk R (1 or more) of one or more exceedance becomes (IACWG, 1982):

$$R(1 \text{ or more}) = 1 - (1-P)^N$$

[Eq. 5]

Equations 4 and 5 were used to calculate the probability of no events and one or more events exceeding the 10,000-year magnitudes in N=10, 20, 30, 40, and 50 years. These results are shown in Table 3 and suggest that during an operating period of 50 years the Menominee River near the Back Forty Project Area has less than a 0.5% chance of observing one or more 10,000-year discharge events.

Table 3. Probability of no flood events (None) and one or more flood events (One or More) exceeding 1000- and 10,000-year discharge magnitudes in *N*=10, 20, 30, 40, and 50 years.

	10,000-year Magnitude (Prob=0.0001)	
Time (years)	None	One or More
10	0.999	0.001
20	0.998	0.002
30	0.997	0.003
40	0.996	0.004
50	0.995	0.005

5 References

IACWG [Interagency Advisory Committee on Water Data], 1982. *Guidelines for determining flood flow frequency: Bulletin 17B of the Hydrology Subcommittee*, U.S. Geological Survey, Office of Water Data Coordination, Reston, Virginia.

Manning, R., 1891. On the flow of water in open channels and pipes. *Transactions of the Institution of Civil Engineers of Ireland* 20:161–207.

Walker, J.F. and W.R. Krug, 2003. *Flood-Frequency Characteristics of Wisconsin Streams*, Water-Resources Investigations Report 03–4250, U.S. Geological Survey, Reston, Virginia.

Attachment 193

AQUILA RESOURCES BACK FORTY PROJECT
UNANTICIPATED DISCOVERY PLAN
REGARDING CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

Purpose

The purpose of this Unanticipated Discovery Plan is to provide guidance for appropriate response in the event that previously unknown cultural resources or human remains are inadvertently discovered during site activity. Although extensive cultural resources surveys have been completed, the potential always exists for unanticipated discoveries even within areas subjected to survey where no cultural resources were identified. Therefore, any personnel disturbing earth for the Back 40 Project should be prepared to deal appropriately with unanticipated discoveries.

Covered Activities

The guidance in this plan applies to any on-site activities that disturb or move earth within five meters of the surface. Examples of such activities include excavating, drilling, grubbing and brushing, and timber harvesting.

Recognizing Cultural Resources

The first step in dealing appropriately with unanticipated discoveries is recognizing cultural resources and human remains when they are encountered. From a general standpoint, cultural resources include anything exhibiting past modification by humans from prehistoric times or from as recent as 50 years ago. They can consist of artifacts or features. Stones broken in a certain way during the manufacture of stone tools are artifacts, as are metal nails or glass fragments from historic activities.

Cultural features are evidence in the ground of previous activities, for example a pit or a trench or a mound. Examples of cultural resources include:

- An accumulation of shell and burned rocks, related to food preparation
- An area of charcoal or very dark stained soil with artifacts
- Stone tools or waste flakes (such as an arrowhead or stone chips)
- Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years
- Buried railroad tracks, decking, or other industrial materials
- Earth mounded up above the normal ground surface, possibly in parallel rows
- A trench or pit excavated below the normal ground surface
- Buried or surficial remains of a structure or foundation
- *Bones suspected to be human, or evidence of human burials or graves – these receive special treatment, as described below*

If an object or a feature in the landscape does not look natural, then it may be cultural. As a conservative approach, the material or feature should be assumed to be a cultural resource if there is any uncertainty pending further assessment by professionals.

Discovery Response Procedures

Cultural Resources

1. If you are engaged in work near the cultural resource, stop work immediately, and secure and protect the discovery location. If you are not engaged in work near the discovery location, mark the spot so that you can find it again.
2. Do not move anything once you are aware that there may be cultural material present, and do not remove anything from the location. If anything has

already been disturbed, leave it where it lies until further instruction. If you can take photos without disturbing anything, please do so.

3. Immediately notify a designated supervisor of the discovery. Do not discuss the discovery with anyone other than your supervisor, unless asked to do so by your supervisor. Once made aware of the discovery, the designated supervisor will notify a qualified archaeologist as soon as possible.
4. Information about the discovery will be provided to the archaeologist, who will determine whether the discovery is in fact cultural, and whether further study is warranted.
5. Once the archaeologist has developed an assessment of the significance of the cultural resource, either based on photographs and descriptions or on a visit to the discovery location, the archaeologist will determine the need for further action, and if needed an action plan will be developed and implemented including any necessary protection or mitigation measures.

Human Remains, Burial, or Grave Site

1. If you are engaged in work near the discovery of possible human remains, burial, or a grave site, stop work immediately, and secure and protect the discovery location. If you are not engaged in work near the discovery location, mark the spot so that you can find it again.
2. Do not move or touch anything once you are aware that there may be human remains or graves present, and do not remove anything from the location. If anything has already been disturbed, leave it where it lies, covered with a tarp for protection, until further instruction.
3. Do not photograph any possible human remains or graves.
4. Immediately notify your supervisor of the discovery. The designated supervisor will notify a qualified archaeologist as soon as possible.

5. Always be sure to treat human remains and graves with respect and dignity. Do not speak to anyone other than your designated supervisor about the discovery, unless asked to do so by your supervisor.
6. If the archaeologist confirms that human remains or graves are present, either based on interviews with on-site personnel or from on-site study, he or she will notify the local coroner.
7. If the coroner determines that the human remains or grave are of recent origin, the discovery location will be treated as a crime scene under the direction of the coroner and local law enforcement officers.
8. If the coroner determines that the human remains or grave are not of recent origin, an action plan will be developed and implemented including any necessary protection or mitigation measures in coordination with appropriate third parties as needed.

Resumption of Work After Unanticipated Discovery

No work should proceed in the vicinity of any unanticipated discovery until the disposition of the discovery is resolved. If work must proceed in the general area of the discovery before the disposition of the discovery is final, full-time monitoring by a qualified archaeologist is recommended.

Contact Information

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Attachment 197

Memorandum

Foth Infrastructure & Environment, LLC

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P.O. Box 5126 • De Pere, WI 54115-5126
(920) 497-2500 • Fax: (920) 497-8516
www.foth.com

June 8, 2016

TO: Andrew Boushy, Aquila Resources Inc.

CC: Steve Donohue, Foth Infrastructure & Environment, LLC
Kris Baran, Foth Infrastructure & Environment, LLC
Master File 14A021/5000

FR: Andrea Martin, Foth Infrastructure & Environment, LLC
Curt Dungey, Foth Infrastructure & Environment, LLC

RE: Back Forty Project - Air Deposition Impact Analysis on Soils
Metals and Sulfate Deposition Screening Assessment

Summary

The purpose of this analysis is to evaluate the potential soil impacts of atmospheric deposition of airborne pollutants from the proposed Aquila Resources Inc. (Aquila) Back Forty Project (Project). This soil analysis complements the air deposition analysis addressing potential surface water quality impacts provided in the Back Forty Environmental Impact Assessment (EIA) (Foth, 2015a).

Air emissions have been estimated from the proposed operation as documented in the *Michigan Air Use Permit- Permit to Install Application* (Foth, 2015b). Mine target metals copper and zinc are included in this analysis, as well as lead and mercury due to their toxicity in the environment. Sulfur is in the ore and concentrate in the form of sulfides. To address possible concerns of deposited sulfides converting to sulfuric acid, the methodology employed in this analysis uses a stoichiometric conversion from sulfur to the sulfate ion to perform the evaluation.

As a representative constituent, deposition modeling results for copper are shown on Figure 1. Contours surrounding the pit and operations diminish with distance from the facility. The highest deposition rates outside the Project Boundary are at the boundary. Fifteen receptor locations are shown on Figure 2 surrounding the pit and operations. These locations have been evaluated for potential soil deposition effects. Deposition will fall on the land and mix in with subsurface soil. The evaluation considers the deposited PM to extend below the surface and mix within 1 centimeter (cm) of the soil surface.

The evaluation results show no exceedance of applicable standards for both one year and the seven year life of mine. Additionally, the evaluation of the maximum sulfate rate generated from the facility is demonstrated to be under the protective sulfate standard. The evaluations are considered conservative because maximum emissions rates are used in the evaluation: actual emissions will vary and will always be under the maximum rate basis. Additionally, very little of the overall Site and affected area will experience the maximum deposition rates. Locations farther from the facility will experience significantly less deposition.

Discussion

Deposition modeling is described in detail in Foth (2015a). In summary, deposition is modeled at over 10,000 receptors spaced in a 200 meter (m) grid across the site. Modeling output data sets include receptor coordinates and deposition of selected constituents. Units of deposition are mass per area per time. This evaluation uses milligrams per square meters per year ($mg/m^2/yr$).

Soil Evaluation

The soil evaluation is presented in Attachment 1 calculations and is comprised of five parts:

Comparative Criteria

NREPA Part 201 Environmental Remediation contains criteria by which to compare soil characteristics: *Table 2. Soil: Residential and Commercial I Part 201 Generic Soil Clean up Criteria*, RRD Operational Memorandum No. 1 (MDEQ, 2006). The following criteria were selected:

- Direct Contact Criteria and Risk Based Screening Levels;
- Drinking Water Protection Criteria and Risk Based Screening Levels; and
- Groundwater Surface Water Interface Protection Criteria and Risk Based Screening Levels.

The Groundwater Surface Water Interface Protection Criteria has several hardness-based criteria: copper, lead, and zinc. The hardness values from the Hydrogeology Report, Environmental Baseline Studies (ERM, 2011) for monitoring wells MW-4, MW-5, MW-8, and MW-9 were averaged to represent the overall shallow groundwater hardness value across the Site. A hardness value of 222.1 mg/L calcium carbonate equivalent was used. These calculations are provided in Attachment 2.

Risk Management Criteria for Metals at BLM Mining Sites (United States Department of Interior, 2004) provides additional criteria for copper, lead, mercury, and zinc. Criteria prevent adverse toxic effects on wildlife and livestock for a variety of mammals and birds. The selected value used in this evaluation is the most stringent wildlife value. As can be seen in Section I of the calculations, the metal screening levels are one or more orders of magnitude lower than the Part 201 cleanup standards.

Selected Receptors Deposition Rates
The selected receptors at the Project Boundary were identified in the deposition model output data set. Locations and coordinates are shown on Figure 2 and are listed in Section II of the calculations with the deposition rates of the selected constituents.

Native Soil Characteristics
Native soil characteristics for selected constituents along with a specific gravity are shown in Section III of the calculations.

Potential Soil Impacts
Potential soil impacts are calculated on the basis of one year and seven years of deposition. Considering one square meter of soil 1 cm thick, the estimate applies the deposition to that mass of soil. For each constituent, the units are converted so that addition is performed on a consistent unit basis. Although the proposed facility will not emit sulfate ion (SO_4^{-2}), a comparison is performed by converting the sulfur deposition rate to sulfate using the molecular weight ratio of those materials. The converted rates can be compared to the sulfate standard.

The potential concentrations are shown in Section IV of the calculations for each location and each constituent for the two durations. As noted, the comparison with the criteria for all values shows no exceedances for either the one year or seven year durations.

Sulfur Deposition Rate
Nationwide sulfate ion deposition rates are tracked and available from the National Atmospheric Deposition Program (NADP) National Trends Network (NTN). The Back Forty Project is closest to NTN site WI 25 in Suring, Wisconsin. The location and the sulfate ion deposition trend graph are shown in Attachment 3. For the last five years of available data, the background deposition rate at this location is 6 kilograms per hectare per year (kg/ha/yr). The rate evaluation considers the background rate plus the additional calculated sulfate rate generated at the Project.

Michigan does not have a standard for sulfate ion deposition, however, Minnesota developed an acid rain standard of 11 kg/ha/yr sulfate to be protective of sensitive aquatic and terrestrial ecosystems (Minnesota Rule 7021 Acid Deposition Standard). Although this standard is no longer in effect due to overall reduction of sulfate deposition (as can be seen in the trend graph in Attachment 3), the standard remains informative in this analysis. As can be seen in Section V of the calculations, the highest predicted sulfate deposition rate is below the Minnesota acid deposition standard.

References

Environmental Resources Management, 2011. *Hydrogeology Report*. September 2011.

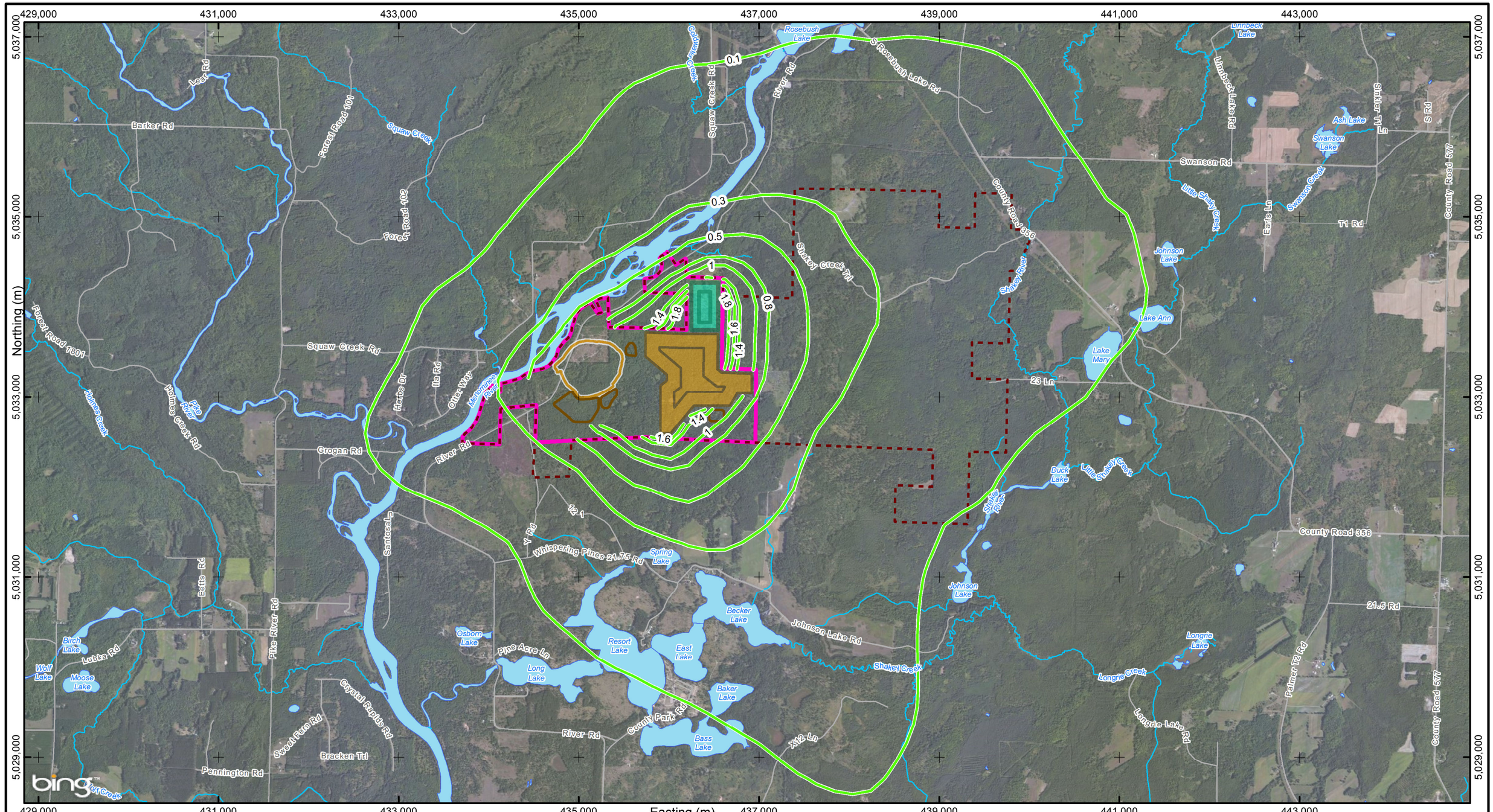
Foth Infrastructure & Environment, LLC. 2015a. *Mining Permit Application Volume II, Environmental Impact Assessment,* Appendix I.

Foth Infrastructure & Environment, LLC. 2015b. *Michigan Air Use Permit – Permit to Install Application*. October 2015.

Michigan Department of Environmental Quality, 2006. *MDEQ RRD Operational Memorandum No. 1, Part 201 Cleanup Criteria, Part 213 Risk-Based Screening Levels, Attachment 1 Table 2. Soil: Residential and Industrial-Commercial I Part 201 Generic Cleanup Criteria and Screening Levels: Part 213 Tier 1 Risk-Based Screening Levels (RBSLs).* January 23, 2006.

United States Department of the Interior, 2004. *Risk Management Criteria of Metals at BLM Sites*. Karl L. Ford. Bureau of Land Management, National Science and Technology Center, Denver, CO. Table 4. Wildlife and Livestock Risk Management Criteria for Metals in Soils. (Technical Note 390, rev. October 2004).

Figures



NOTES

1. Aerial supplied by Esri and its data suppliers.
2. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
3. TWRMF footprint is based upon non-segregated tailings and may be modified based upon input from Aquila.
4. Current pit design supplied by Aquila via email in May 2015.
5. Plant site features provided by Lycopodium in July 2015.
6. Deposition modeling was performed by Foth using AERMOD based on maximum calculated emission rates. Annual deposition rates were determined by including data on particle density, particle diameter and mass fraction. Preprocessed meterology data from the Memominee-Marinette station for 2014 were used in the analysis.

LEGEND

- Major Road
- Minor Road
- Streams
- Copper Depositon Contours (milligrams/square meter/year)
- Lakes/Rivers
- Soil and Topsoil Stockpiles
- Sulfide TWRMF
- Oxide TWRMF
- Designed Pit Perimeter
- Mineral Property Boundary
- Project Boundary

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	AKM	DATE:	JUN. '16
REVIEWED BY:	CED1	DATE:	JUN. '16
APPROVED BY:	CED1	DATE:	JUN. '16

BACK FORTY PROJECT

FIGURE 1

SOIL DEPOSITION ANALYSIS
COPPER DEPOSITION MODELING RESULTS - 2014
STEPHENSON, MICHIGAN

Scale: 0 400 800 1:40,000 Meters

Date: JUNE 2016

Drafted by: DAT

Project No: 14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\EIA\Response\Figure 1 Copper Deposition Modeling Results - 20141.mxd Date: 6/6/2016

Num	X	Y
1	434723.2	5033342
2	434967.8	5033656
3	435348.1	5033771
4	435723	5033762
5	436201.7	5033771
6	436201.7	5034146
7	436201.7	5034336
8	436599	5034319
9	436593.7	5033781
10	436589.2	5033331
11	436954.5	5033304
12	436907.6	5032490
13	435907.6	5032490
14	434907.6	5032490
15	434507.6	5032890

NOTES

1. Topographic basemap from Esri and its data suppliers. Topographic contours shown in feet above mean sea level.
2. Horizontal datum based on NAD 1983. Horizontal coordinates based on UTM Zone 16 North.
3. Current pit design supplied by Aquila via email in May 2015.

LEGEND

- Deposition Location
- Designed Pit Perimeter
- Mineral Property Boundary
- Project Boundary
- Roads
- Flotation TWRMF
- Oxide TWRMF

Aquila Resources Inc.

Foth

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	AKM	DATE:	JUN. '16
REVIEWED BY:	CED1	DATE:	JUN. '16
APPROVED BY:	CED1	DATE:	JUN. '16

BACK FORTY PROJECT

FIGURE 2
SOIL DEPOSITION ANALYSIS
SELECTED DEPOSITION RATES
SURROUNDING THE PROJECT
STEPHENSON, MICHIGAN

Scale: 0 150 300 1:15,000 Meters | Date: JUNE 2016

Drafted by: DAT | Project No: 14A021

Path: X:\GB\IE\2014\14A021-00\GIS\mxd\EIA\Response\Figure 2 Locations of Highest Deposition Rates.mxd Date: 6/6/2016

Attachment 1

Soil Evaluation Calculations

Client: Aquila Resources, Inc. Project ID.: 14A021.15
Project: Back 40 Project - Menominee County, Michigan
Prepared by: AKM Date: 06/03/16
Checked by: CED1 Date: 06/06/16

I Comparative Criteria for Soils

	Copper mg/kg (ppm)	Lead mg/kg (ppm)	Mercury mg/kg (ppm)	Sulfur mg/kg (ppm)	Sulfate [1] mg/kg (ppm)	Zinc mg/kg (ppm)
Direct Contact Criteria and Risk Based Screening Level [2]	20000	400	160	n.a.	n.a.	170000
Drinking Water Protection Criteria and Risk Based Screening Level [2]	5800	700	1.7	n.a.	5000	2400
Groundwater Surface Water Interface Protection Criteria and Risk Based Screening Level [2]	100	6900	0.05	n.a.	n.a.	200
Risk Management Criteria for Metals at BLM Mining Sites [3]	7	6	1	n.a.	n.a.	43

II Selected Deposition Receptors and Deposition Rate

Location	X Coordinate	Y Coordinate	Deposition Rate Copper mg/m2/year	Lead mg/m2/year	Mercury mg/m2/year	Sulfur mg/m2/year	Sulfate [1] mg/m2/year	Zinc mg/m2/year
1	434723.2	5033342	0.9	1.1	0.017	47.8	143	15.8
2	434967.8	5033656	0.9	1.2	0.017	50.4	151	15.9
3	435348.1	5033771	1.0	1.0	0.015	52.0	156	13.9
4	435723	5033762	1.3	1.2	0.017	69.5	209	16.0
5	436201.7	5033771	2.2	1.3	0.016	124.6	374	14.7
6	436201.7	5034146	1.8	0.9	0.010	106.4	319	9.1
7	436201.7	5034336	1.0	0.6	0.007	60.1	180	6.4
8	436599	5034319	1.4	0.7	0.007	84.7	254	6.7
9	436593.7	5033781	2.0	1.0	0.012	116.9	351	11.5
10	436589.2	5033331	1.9	1.1	0.016	95.5	287	14.4
11	436954.5	5033304	0.9	0.6	0.009	47.7	143	8.1
12	436907.6	5032490	0.5	0.4	0.005	27.8	84	4.8
13	436907.6	5032490	1.5	1.8	0.029	65.5	196	27.7
14	436907.6	5032490	0.4	0.4	0.007	20.5	62	6.4
15	436507.6	5032890	0.4	0.4	0.006	19.7	59	5.5

III Soil Characteristics of Native Soils

		Copper	Lead	Mercury	Sulfur	Sulfate [1]	Zinc
Soil Composition [4]	mg/kg (ppm)	4.5	3.7	0.0089	44.5	133.5	18.3
specific gravity of soil [5]:		1.33					

IV Potential Soil Impacts

If one year of deposition mixed with the top 1 centimeter (cm) of soil, the soil characteristics could potentially be:

Mass of soil:
volume = 1 m x 1 m x 1 cm = 0.01 m3 mass of soil per m2 by 1 cm deep = 13.3 kg per m2

Estimating the potential concentration after 1 year of deposition:
Potential concentration = native soil composition mg/kg + (one year deposition mg/m2/13.3 m2/kg)

Location	Copper mg/kg (ppm)	Lead mg/kg (ppm)	Mercury mg/kg (ppm)	Sulfur mg/kg (ppm)	Sulfate [1] mg/kg (ppm)	Zinc mg/kg (ppm)
1	4.6	3.8	0.010	48.1	144.3	19.5
2	4.6	3.8	0.010	48.3	144.9	19.5
3	4.6	3.8	0.010	48.4	145.2	19.3
4	4.6	3.8	0.010	49.7	149.2	19.5
5	4.7	3.8	0.010	53.9	161.6	19.4
6	4.6	3.8	0.010	52.5	157.5	19.0
7	4.6	3.7	0.009	49.0	147.1	18.8
8	4.6	3.7	0.009	50.9	152.6	18.8
9	4.7	3.8	0.010	53.3	159.9	19.2
10	4.6	3.8	0.010	51.7	155.0	19.4
11	4.6	3.7	0.010	48.1	144.3	18.9
12	4.5	3.7	0.009	46.6	139.8	18.7
13	4.6	3.8	0.011	49.4	148.3	20.4
14	4.5	3.7	0.009	46.0	138.1	18.8
15	4.5	3.7	0.009	46.0	137.9	18.7

No exceedance of applicable standards are identified.

If 7 years of deposition is mixed with the top 1 cm of soil, the soil characteristics could potentially be:

Location	Copper mg/kg (ppm)	Lead mg/kg (ppm)	Mercury mg/kg (ppm)	Sulfur mg/kg (ppm)	Sulfate [1] mg/kg (ppm)	Zinc mg/kg (ppm)
1	5.0	4.3	0.0	69.6	208.9	26.6
2	5.0	4.3	0.0	71.1	213.2	26.7
3	5.0	4.2	0.0	71.9	215.6	25.6
4	5.2	4.3	0.0	81.1	243.3	26.7
5	5.7	4.4	0.0	110.1	330.2	26.1
6	5.4	4.2	0.0	100.5	301.5	23.1
7	5.0	4.0	0.0	76.1	228.4	21.7
8	5.2	4.0	0.0	89.1	267.2	21.8
9	5.6	4.2	0.0	106.0	318.1	24.4
10	5.5	4.3	0.0	94.8	284.3	25.9
11	5.0	4.0	0.0	69.6	208.9	22.5
12	4.8	3.9	0.0	59.1	177.4	20.8
13	5.3	4.7	0.0	79.0	236.9	32.9
14	4.7	3.9	0.0	55.3	165.9	21.7
15	4.7	3.9	0.0	54.9	164.6	21.2

No exceedance of applicable standards are identified.

V Evaluation of Sulfate Deposition Rate

To compare the highest sulfate deposition rate of the project on the environment to the standard, convert the standard [6] for SO4 ion from kg/ha/yr to mg/m2/yr.

11	kg [6] / ha-year	1000	g / kg	1000	mg / g	ha / 10000 m2	= 1100 mg/m2/yr

Background Sulfate Deposition Rate [7]:

6	kg / ha-year	1000	g / kg	1000	mg / g	ha / 10000 m2	= 600 mg/m2/yr

Highest sulfate deposition rate of the 15 locations: (Receptor Location 5)	374 mg/m2/yr
Total highest predicted sulfate deposition rate:	974 mg/m2/yr
Is the highest sulfate deposition rate compliant with the acid deposition standard?	Yes

Notes

1 Sulfate is a calculated value. Sulfate is potentially present based on all sulfur converting to sulfate. Based on their respective molecular weights, there could be 3 times the mass of sulfate as sulfur.

2. Michigan Part 201 Generic Cleanup Criteria and Screening Levels/Part 213 Risk-Based Screening Levels, Table 2 Soil: Residential, rounded.

3. US Department of Interior - Bureau of Land Management, 2004. Risk Management Criteria for Metals at BLM Mining Sites, Technical Note 390 rev. October 2004. Values selected from Table 4 are the most stringent.

4. Foth, 2015. Memorandum: Waste Rock, Tailings, and Soil Metal Concentrations Measured During Static Testing. August 19, 2015.

5. U.S. Department of Agriculture Natural Resources Conservation Service, *Soil Quality Indicators* publication on typical bulk density of soils.

6. Minnesota Rule 7021 Acid Deposition Control: 7021.0030 Acid Deposition Standard: 11 kg wet sulfate deposition per hectare per year. Although this rule is no longer in effect in Minnesota, the value provided is the only identified protective deposition standard for sulftate and is therefore informative in this analysis.

7. National Atmospheric Deposition Program, NTN Site WI25 in Suring WI. Average deposition value 2008 through 2013, most recent data.

Attachment 2

Groundwater Surface Water Interface Protection Criteria and Risk Based Screening Levels Calculations

Calculation of Generic Facility-Specific Part 201 Groundwater Surface Water Interface (GSI) Criteria for {G} Footnoted Hazardous Substances

Directions for calculating generic facility-specific GSI criteria:

1. Enter **"hardness"** (Column C) or **"pH"** (Column D). Click the green check mark to the left of the Excel formula bar or press the "Enter" key.
2. The GSI criteria for surface water **not** protected as a source of drinking water are the lower of the final chronic value (FCV), wildlife value (WV), and the surface water human non-drinking water value (HNDV). These criteria are presented in Column L.
3. The GSI criteria for surface water protected as a source of drinking water are the lower of the FCV, WV, and surface water human drinking water value (HDV). Surface water protected as a source of drinking water includes the Great Lakes and their connecting waters, and inland surface water in close proximity to a water supply intake. These criteria are presented in Column M. Refer to Part 201 Criteria Application Guidesheet #3 for further guidance on selecting the applicable GSI criterion.
4. The final acute values (FAV) protective of aquatic life are presented in column E. The calculation of the FAV is provided to allow the identification of any exceedance of an acute GSI criterion. Where an exceedance of an acute GSI criterion exists, an evaluation must be done to determine appropriate action in accordance with provisions of R 299.5716, R 299.5526(4) and RRD Operational Memorandum No. 5.

Calculate GSI in ug/L (ppb)

Hazardous Substance	Chemical Abstract Service Number (CAS #)	* ENTER Hardness in mg CaCO3/L	* ENTER pH	Final Acute Value (FAV)	FAV Conversion Factor	Final Chronic Value (FCV)	FCV Conversion Factor	Wildlife Value (WV)	Surface Water Human Non-Drinking Water Value (HNDV)	Surface Water Human Drinking Water Value (HDV)	GSI Criteria for Surface Water Not Protected for Drinking Water Use	GSI Criteria for Surface Water Protected for Drinking Water Use
Acetate	71501	NA	**pH**	Calculated	NA	Calculated	NA	NA	1.3E+6	16,000	Calculated	Calculated
Acetic acid	64197	NA	**pH**	Calculated	NA	Calculated	NA	NA	1.3E+6	16,000	Calculated	Calculated
Barium	7440393	**hardness**	NA	Calculated	NA	Calculated	NA	NA	1.6E+5	1,900	Calculated	Calculated
Beryllium	7440417	**hardness**	NA	Calculated	NA	Calculated	NA	NA	1,200	160	Calculated	Calculated
Cadmium	7440439	**hardness**	NA	Calculated	Calculated	Calculated	Calculated	NA	130	3	Calculated	Calculated
Chromium (III)	16065831	**hardness**	NA	Calculated	NA	Calculated	0.86	NA	9,400	120	Calculated	Calculated
Copper	7440508	**222.1**	NA	57.00574967	NA	1.8E+1	0.96	NA	38,000	470	1.8E+1	1.8E+1
Lead	7439921	**222.1**	NA	747.7459983	0.674740258	3.9E+1	0.674740258	NA	190	14	3.9E+1	1.4E+1
Manganese	7439965	**hardness**	NA	Calculated	NA	Calculated	NA	NA	59,000	1,300	Calculated	Calculated
Nickel	7440020	**hardness**	NA	Calculated	NA	Calculated	0.997	NA	2.1E+5	2,600	Calculated	Calculated
Zinc	7440666	**222.1**	NA	460.8034969	NA	2.3E+2	0.986	NA	16,000	3,300	2.3E+2	2.3E+2
Pentachlorophenol	87865	NA	**pH**	Calculated	NA	Calculated	NA	NA	2.8	1.8	Calculated	Calculated

NA = Criterion or value is not available or not applicable.

* The formulas in this spreadsheet depend upon appropriate entries in these cells. Do not leave these cells blank. If numeric hardness or pH values are not available, enter the word "hardness" or "pH" in the appropriate cell.

To evaluate copper, lead, and zinc criteria, an average hardness value was developed considering 4 monitoirng wells within the Project Boundary. From ERM Hydrogeology Report, ERM, 2011

MW-4	MW-5	MW-8	MW-9		
190	260	280	200	average=	222.1
200	230	280	230		
210	220	260	170		
160	200	270	190		
160	240	340	210		
220	250	250	200		
220	230	250	200		
190	220	270	180		
190	180				

Prepared by: AKM
Checked by: MCC2

Calculation of Generic Facility-Specific Part 201 Soil GSI Protection Criteria (GSI PC)

Directions for calculating a generic facility-specific soil GSI PC:

1. Manually type in the **"GSI"** criterion calculated on the previous page, rounded to 2 significant figures. DO NOT CUT AND PASTE as this will enter the unrounded value and generate a different value. Click the green check mark to the left of the Excel formula bar or press the "Enter" key.
2. The GSI PC will calculate and appear in Column W. The GSI PC are the higher of the Soil-Water Partition Value for GSI (Column U) and the 20 X GSI value (Column V).

Calculate Soil GSI PC in ug/Kg (ppb)								
Hazardous Substance	**Chemical Abstract Service Number (CAS #)**	*** ENTER GSI**	**Soil-Water Distribution Coefficients (Kd) L/Kg**	**Henry's Law Constant (HLC) atm-m3/mol**	**Soil Organic Carbon-Water Partition Coefficient (Koc) L/Kg**	**Soil-Water Partition Value for GSI ug/Kg**	**20 X GSI ug/Kg**	**Soil GSI PC ug/Kg**
Acetate	71501	**GSI**	NA	NA	NA	Calculated	Calculated	Calculated
Acetic acid	64197	**GSI**	NA	NA	NA	Calculated	Calculated	Calculated
Barium	7440393	**GSI**	41	NA	NA	Calculated	Calculated	Calculated
Beryllium	7440417	**GSI**	790	NA	NA	Calculated	Calculated	Calculated
Cadmium	7440439	**GSI**	75	NA	NA	Calculated	Calculated	Calculated
Chromium (III)	16065831	**GSI**	1.8E+6	NA	NA	Calculated	Calculated	Calculated
Copper	7440508	**1.8E+1**	360	NA	NA	1.0E+5	3.6E+2	1.0E+5
Lead	7439921	**3.9E+1**	11,000	NA	NA	6.9E+6	7.8E+2	6.9E+6
Manganese	7439965	**GSI**	NA	NA	NA	Calculated	Calculated	Calculated
Nickel	7440020	**GSI**	65	NA	NA	Calculated	Calculated	Calculated
Zinc	7440666	**2.3E+2**	62	NA	NA	2.3E+5	4.6E+3	2.3E+5
Pentachlorophenol	87865	**GSI**	NA	2.44E-8	592	Calculated	Calculated	Calculated

NA = Criterion or value is not available or not applicable.

* The formulas in this spreadsheet depend upon appropriate entries in these cells. Do not leave these cells blank. If numeric GSI values are not available, enter "GSI" in the appropriate cell.

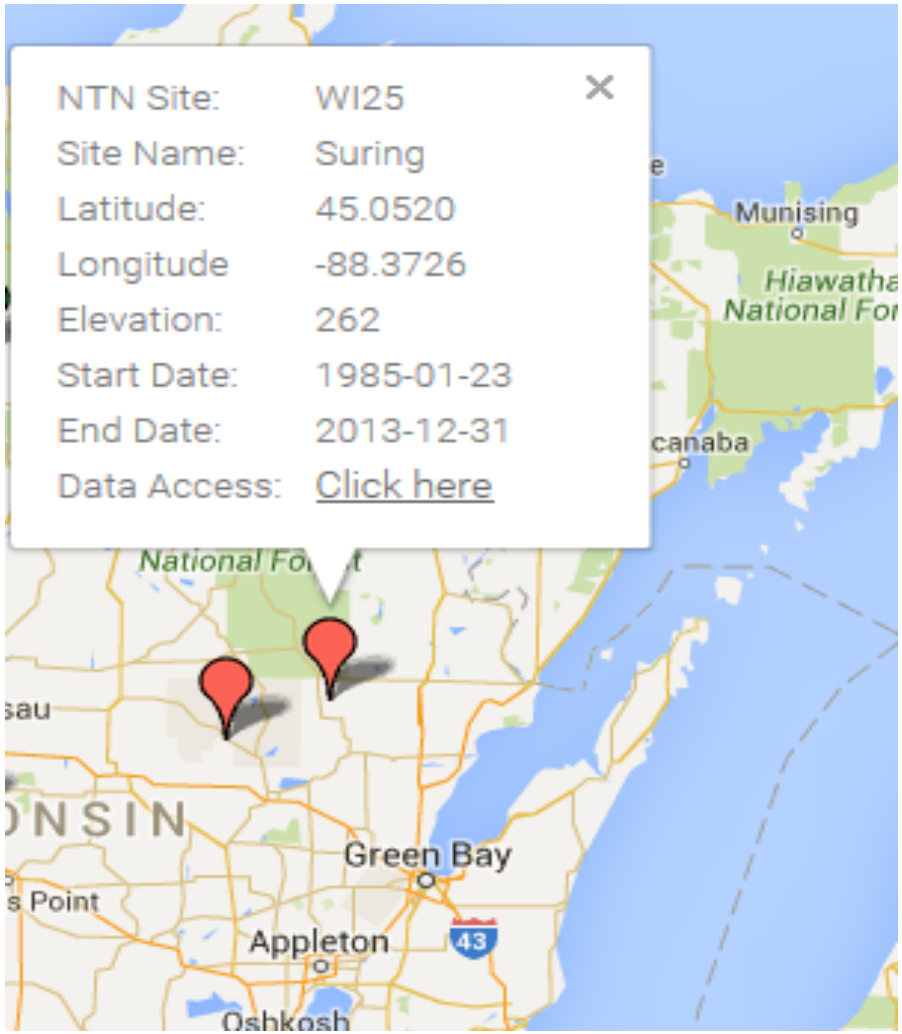
Prepared by: AKM
Checked by: MCC2

Attachment 3

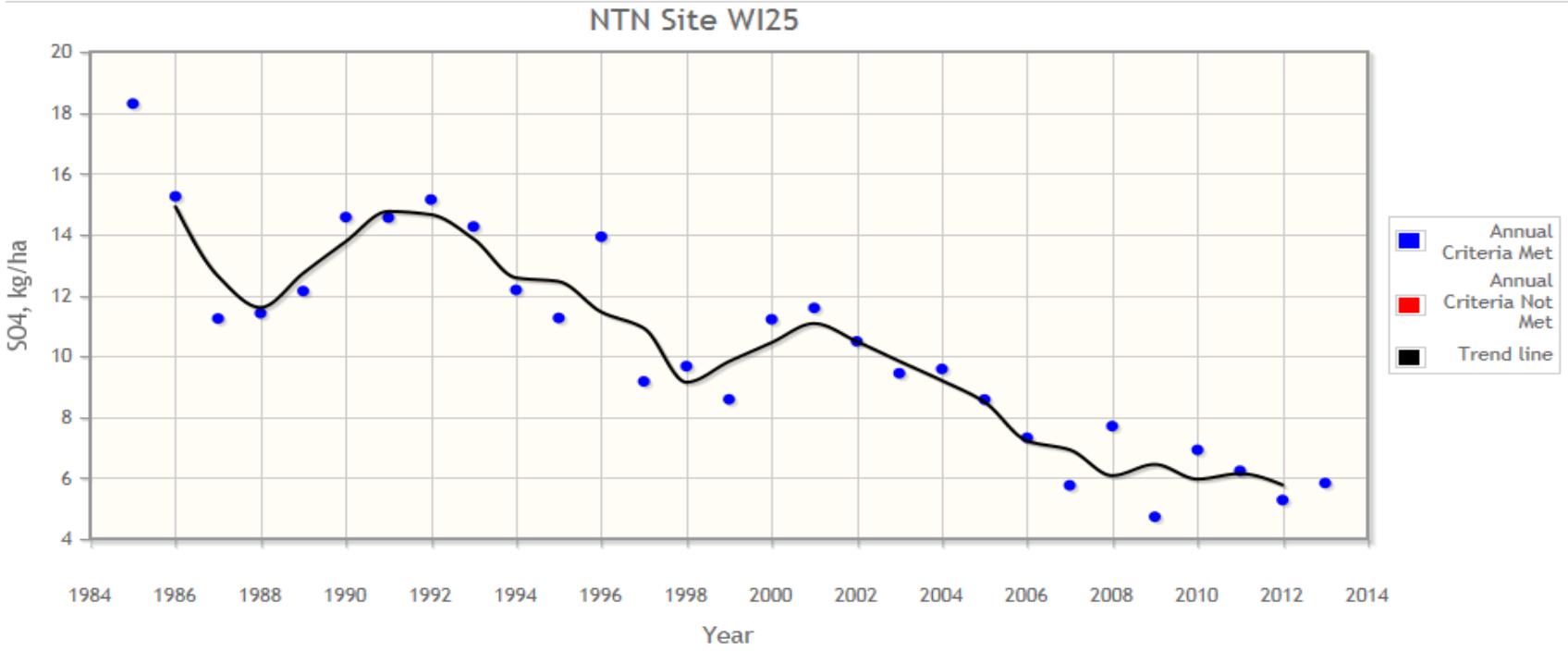
National Atmospheric Deposition Program
NTN WI25 Sulfate Deposition

National Atmospheric Deposition Program

Sulfate Deposition in the Vicinity of Back Forty Project, Stephenson Michigan



National Atmospheric Deposition Program



What to Plot

Concentration

pH | SO_4 | NO_3 | NH_4 | Ca | Mg | K | Na | Cl

Equivelents

H | SO_4 | NO_3 | NH_4 | Ca | Mg | K | Na | Cl

Deposition

H | SO_4 | NO_3 | NH_4 | Ca | Mg | K | Na | Cl | Total N

Precipitation

PPT

More Information

Annual Criteria:

The annual weighted mean concentrations and depositions are characterized as meeting or not meeting the NADP's data completeness criteria for each 1-year period.

1. Valid samples for 75% of the time period
2. Valid samples for 90% of the precipitation amount
3. Precipitation amounts for 75% of the time period