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To: Bruce Farling, Montana Trout Unlimited

From: James R. Kuipers, P.E., Kuipers & Associates LLC

Re: Technical Information Requests for the
Mine Operating Permit Application, Black Butte Copper Project, Meagher County, MT
Submitted by Tintina Montana, Inc., Black Butte Copper Project
Submitted to Director Hard Rock Section, Montana Department of Environmental Quality, Environmental Management Bureau
December 15, 2015

I have reviewed the above referenced Black Butte Copper Project Mine Operating Permit Application ("MOPA"). The following additional technical information is recommended to ensure the MOPA and supporting documents contain sufficient data and evaluations for DEQ to begin preparation of the appropriate environmental analysis document, and make an informed permit decision. Based on our knowledge with respect to mine operations and potential environmental risks the following supplementary information, as described further in comments herein, with respect to mine operations and reclamation and closure is needed to support a thorough and comprehensive risk assessment of the proposed project, including the determination of the significance of potential project effects:

- Because changes to original mine operating plans are common additional information and analysis needs to be provided on the cause and effects of potential operational risks that are common to underground mining projects such as higher inflow of water, ground control or other issues resulting in a change in mining methods, dilution of ore with waste, delays in backfilling, etc.,.
- The tailings and waste rock repository as described in the MOPA requires perpetual care and maintenance and a full suite of options should be considered to reduce or eliminate long-term acid generation potential. For example, because the flotation tailings will contain liberated pyrite that is not recovered in the copper bearing concentrate opportunity exists to decrease the potential for acid generation of reposited tailings material by separating out the pyrite and returning it to the mine for long-term storage below the water table.
- The design of the tailings and waste rock repository needs to be better explained and options analyzed particularly in terms of long-term viability, monitoring, maintenance, and potential for failure including critical aspects such as addressing underlying groundwater and drainage, liner installation and long-term viability/replacement, and land use controls in particular relative to perpetual care and maintenance.
- Because it is critical to the project meeting the projected performance in terms of water quality the approach to water treatment and disposal of water treatment waste products needs to be more thoroughly justified and the proposed plan as well as any options thoroughly considered to ensure the viability of the water management and treatment plan.

- The reclamation and closure plan needs to consider early closure scenarios and describe the proposed activities in greater detail in particular with respect to long-term operations, monitoring and maintenance and needs to be supplemented by a multi-stakeholder Failure Modes Effects Analysis and should be supported by an Adaptive Management Plan in addition to a detailed financial assurance cost estimate.
- Because there is clear potential for additional mining beyond that proposed in the MOPA by the Lowry and other deposits acknowledged by BBC, and only if it is considered at this early stage in project planning can any real technical or other means to optimize the short-term plans to allow for long-term effects be identified and implemented, a 25-50-yr scenario at double the proposed throughput should be analyzed and presented as a supplement to the MOPA as even if done on a highly theoretical basis it will allow for the true impacts of this original development to be evaluated in terms of the significance of potential project effects.

3.2.2.3 Mine Dewatering

"Early modeling efforts predicted groundwater flows into the mine in the range of 530 to 680 gallons per minute, assuming lack of any inflow controls. Occasional short-term higher flows generated by rapid dewatering of fracture systems encountered by mining could be as high as 1,000 gallons per minute. When mining encounters significant inflows of water from water-bearing faults and/or fractured zones, pressure grouting techniques may be used to control the inflow of water into the mine. Pressure grouting is a widely accepted standard practice in the mining industry. It involves injecting a grout material into fractured rock to seal of waterways, and divert the water around the underground mine openings."

"Tintina plans to control the flow of water from the mine to a maximum of about 500 gallons per minute (1,893 Lpm). The water treatment system design is optimized in the range of 500 gallons per minute (1,893 Lpm) of continuous flow, with maximum inflow rates of about 510 gallons (1,930 Lpm) per minute."

- Additional details need to be provided concerning contingency measures if high flow rates of 1,000 gpm are encountered over a sustained period of time.
- Additional details need to be provided on pressure grouting techniques including:
    - the different types of pressure grouting techniques to control water inflows,
    - the pros and cons of the various techniques and the relative effectiveness of the various techniques,
    - case study information on pressure grouting techniques, and
    - alternatives that could be used as a contingency to pressure grouting techniques.

"Dewatering of the underground mine workings will produce all water needed for consumptive use by mining operations (about 210 gallons (790 L/min) per minute or 0.47 cubic feet per second)."

- Additional details need to be provided concerning contingency measures if the underground mine workings do not produce all the water needed for consumptive use by mining operations.

3.2.2.4 Mining Rates and Schedules

"Therefore, only about a few percent of the mining stopes will be exposed to atmospheric oxygen and underground weathering conditions for about 60 to 90 days each at any given time in the entire mine life."

- Additional details supporting this statement need to be provided including a detailed mine schedule that shows how this would be achieved as well as a technical analysis indicating the extent to which it is practically and economically achievable. The additional detailed information should address to what extent this practice is achieved at other mine sites and provide examples.

"Approximately 18 active mining stopes (headings) (Table 3-3) will be required to insure that the design production rate of 3,300 tons per day can be achieved."

- Additional information needs to be provided on active mining stopes including the number of standby or additional stopes that would be required to accomplish 18 "active" stopes at all times. Additional information should be provided on how the flow of materials and supplies, workers, equipment, ore and waste and other aspects will be accomplished within a relatively tight footprint and using a single-access portal.

3.2.2.7 Other Major Components of Underground Mining

"Blasting Agents"

- Additional information needs to be provided on blasting agents and the potential use of alternative blasting agents in the event of unexpected impacts from nitrogen based explosives. An evaluation should be provided of the various types of explosives or methods that could be used to limit explosives usage (ANFO, emulsion stick, emulsion pumpable, other explosives or methods of rock breakage). Additional information should be provided on "Exceptional "good housekeeping" efforts…" including written procedures or plans that would support those efforts.

"In addition to minimizing nitrogen input at the source, Tintina will remove nitrogen to below non-degradation standard with the water treatment system."

- As nitrogen occurs in many forms (nitrate, nitrite, ammonia, etc.) additional information needs to be provided on the types associated with blasting agents and the eventual breakdown of those agents. In addition information needs to be provided on the ability of the water treatment system to address the various species of nitrogen and nitrogen compounds that could result.

Underground Sumps: "In addition, sufficient retention time in these sumps, with or without the use of flocculants, will allow partial removal of suspended sediment from underground mine waters prior to pumping to the WTP clarifiers located in the mill."

- Information needs to be provided showing the assumptions and calculations used to determine "sufficient" retention time in the sumps.

3.3.1 Processing Method

"A "flotation" process will liberate fine-grained copper minerals from the bulk of the mined rock to form the copper concentrate."

- The application needs to Identify additional metallurgical test work that has been undertaken or is planned prior to/during construction and operation to improve the flotation process recovery. The application needs to identify if any bulk sampling and metallurgical testwork will take place that might also allow for additional geochemical testing of tailings.
- The application needs to identify and discuss alternatives to the flotation process.
- The application needs to discuss whether a desulphurization process using gravity or flotation methods was considered and tested as an additional process to isolate and allow for storage of already liberated pyrite in the tailings as underground backfill.

3.3.2.6 Tailings Dewatering and Paste Handling Methods

"Tailings from the milling process will be dewatered using a separate high-rate thickener and flocculent (a chemical that causes colloids to form, and other suspended particles in liquids to aggregate, forming a floc) to initially achieve a solid density of 60%. The tailings will be further dewatered to 70-85% solids using a vacuum filter. Thickened tailings will be sent to a paste plant (Figure 3.6 and Figure 3.7) where cement, fly ash, and slag will be added as binders. Then they will be used for structural backfill in underground workings or placed as cemented paste tailings in the CTF."

- The application needs to provide all information and rationale used for the selection of the proposed tailings dewatering and paste handling methods over alternative disposal methods.

"Paste tailings deposited in the CTF will have a total binder content of 0.5 to 2%, whereas cemented paste used as structural backfill underground will have a binder content of approximately 4% in order to provide the necessary additional strength to stand up as walls in the underground workings. Binder of fly ash and slag are available that meet the chemical requirements of ASTM standards for use in cement (i.e., ASTM C618 for a fly ash for use in concrete)."

- The application needs provide additional information as to the basis for paste tailings in the CTF having a binder content of 0.5 to 2% for dust control and what alternative methods to control tailings dust were evaluated. Additional information needs to be provided on "fly ash" and "slag" characteristics including potential hazardous materials and potential sources of those materials. Provide information on source and supply of cement, fly ash and slay as well as potential off-site effects.

3.4.2.2 Topsoil and Subsoils Handling (Stockpiles)

"Diversion ditches will be installed uphill from each of the facilities to intercept non-contact water surface drainage, and convey it to existing drainage outlets."

- The application needs to provide design standards and details for topsoil and subsoils handling diversion ditches.

3.4.2.4 Basin Excavation, Shaping, and Subgrade Preparation

"This will achieve the grades and surfaces required for the installation of the geomembrane."

- The application needs to provide information on the "grades and surfaces required for installation" of the geomembrane.

"It is anticipated that the CTF cut will extend below the groundwater table and care will need to be taken during design, layout and construction of the foundation drain system to control site drainage. Erosion control including surface water diversions and dewatering measures will be implemented on an as needed basis to manage groundwater seepage into the construction site. The foundation drain systems that underlie the embankments need to be constructed first because the embankments will require material sourced from inside the impoundment."

- Additional details need to be provided including drainage management and accommodation of the proposed CTF liner system.

3.4.2.5 Geomembrane and Geonet Installation

"Two 100 mil HDPE geomembranes will be placed over the entire footprint of the basin and on the upstream embankment and side slopes of the CWP, CTF and the PWP. The HDPE geomembrane panels will be welded together by thermal methods. Non-woven geotextile will be placed below and above the geomembrane to protect it. A high drainage capacity geonet liner will be placed between the two HDPE geomembrane layers at the PWP, CTF and CWP. The geonet liner will collect any seepage through the upper liner and deliver this to a sump for removal. Quality Assurance and Quality Control (QA/QC) procedures implemented during construction will minimize the potential for construction defects."

- The rationale for the sufficiency of a 100 mil geomembrane liner needs to be provided.

3.4.2.6 Basin Underdrains

"A basin underdrain will be constructed above the HDPE geomembrane within the CTF basin." "Approximately 165,300 tons (150,000 tonnes) of waste rock from pre-production will be removed from the temporary waste rock storage pad near the mine adit and crushed so that it meets the material specifications for the basin underdrain."

- Additional details such as the "material specifications" need to be provided on the basin underdrain.

3.4.2.8 Instrumentation

"Instrumentation will be installed in the CWP, CTF, PWP and NCWR embankment fill zones and underlying foundations. The instruments will be monitored during construction and ongoing operations to assess performance."

- The application needs to provide additional information and discussion on how the monitoring will meet minimum regulatory and industry best practice to ensure minimization of risks including by early detection of potential issues.

3.5.1 Geotechnical Foundation Evaluations

The site investigation was conducted between March and May 2015, and was split into two phases. The first phase was carried out in March, 2015, during which 19 geotechnical holes were drilled. Four of those 19 holes, were selected to have standpipe piezometers installed for the purposes of long term water quality testing and groundwater elevation monitoring. The second phase was carried out in May, 2015 and consisted of 5 geotechnical drill holes and 44 test pits.

- Additional information needs to be provided on the rationale for the site-specific selection for placement of the various geotechnical drill holes and pits as well as the extent to which existing information is representative or adequate. Information on future additional geotechnical foundation evaluations also needs to be provided.

3.5.2 Design Standards

"The design criteria for the waste and water management facilities have been developed to satisfy both US and international standards."

- The application needs to identify the Canadian Dam Association Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams, 2014 and explain why it was no used to develop the design standards for the project.
- The application needs to include discussion of or a dam breach analysis with water/tailings inundation modeling consistent with the Canadian Dam Association's dam safety guidelines.
- The application needs to specifically address how the design and operation of the facilities is intended to respond to the recommendations of the Mt Polley Independent Review Panel[1] as well as the more recent Samarco, Brazil catastrophic tailings failure.
- The application needs to include comparisons with other similar lined CTF analogs within similar environments. The discussion should include details on permeability, stress, strength, and performance of these structures, including in terms of containment of seepage.
- The application needs to include evidence demonstrating that the design or predicted stability of and seepage from the proposed CTF can be achieved through a post-closure period lasting thousands of years. The application needs to include a discussion on technically feasible options for managing the risk to groundwater and surface water and other environmental receptors in perpetuity.
- The application needs to address the establishment of an Independent Review Panel (IRP) and include a framework and associated details for the establishment of the IRP including its structure, scope and timing. The framework needs to include relevant details such as expert reviewers' qualifications, their roles and continued involvement over the mine life. This framework will demonstrate a commitment to those aspects of the Project where external review from the IRP will be obtained. At a minimum the application should indicate whether the IRP will provide oversight for the following:
    - alternatives assessment for tailings and waste rock management;
    - risk assessment for the chosen method for tailings and waste rock management;
    - design of tailings and waste rock management infrastructure;
    - change management framework;
    - technical review framework;

[1] https://www.mountpolleyreviewpanel.ca/final-report

    - hazard classification and rationale for the proposed TMF dam; and dam breach/inundation study.
- The application needs to provide information on whether the Proponent will provide outcomes from the IRP's work prior to entering the environmental assessment process.

3.5.5.4 CTF Stability Analyses

"The CTF embankment exceeds the factor of safety requirement for all cases modelled."

- The application needs to provide information on sensitivity analysis relative to critical strength parameters and assumptions such as saturated depth.
- The application needs to include an explanation of the likelihood and implications of saturation of the CTFs foundation, drains, and lower portions post-operations.

3.5.6.2 CTF and PWP Seepage Analysis

"Therefore, total potential seepage from the facility will be limited by the upper liner at a rate of 4.2 gallons per day (16 L/day), and even then only under conditions where the CTF is inundated with water for a prolonged period of time."

- The application needs to further elaborate on potential seepage from the CTF in terms of overall water balance including water from the underdrain and geonet liner layer. The application needs to consider potential breakdown of the liner over time and/or more major construction defects than estimated.

3.6.4.2 Liner and Seepage Reclaim Water Systems

"The WRS pad will have a 100 mil (2.5 mm, 0.1 inch) HDPE geomembrane with a minimum 12-inch (300 mm) thick layer of bedding material above and below it for protection from the mine fleet traffic during waste rock placement."

- The application needs to discuss why no drainage collection and transport layer (typically sized gravel and piping network) is incorporated above the liner and below the bedding material in the WRS pad design.

3.6.4.5 Operational Copper-enriched Rock Storage Facility

"The copper-enriched rock storage pad will be used throughout the remainder of the operating mine life."

- The application needs to provide requirements for additional copper-enriched (e.g. low grade) rock storage should it become desired or necessary.

3.6.7.2 CTF Waste Rock Co-disposal during Operations

"Waste rock will be generated throughout the life of the mine."

- Additional information needs to be provided on how co-disposal of tailings and waste rock will be accomplished given that there are few operating examples of this practice and alternatives analysis at other sites has shown some operators to consider the approach to be operationally impractical and unproven.

3.7.2 Water Balance 3.7.2.1 Model Methodology

"The water balance model uses the determined mean monthly precipitation and evaporation values as inputs for each year." "Three separate scenarios were modeled using the life-of-mine water balance in order to obtain an understanding of the water requirements of the mill facility on the PWP volumes during operations. The model was run deterministically for the mean case, and stochastically for the wet (95th percentile) and dry (5th percentile) cases."

- Additional water balance information is needed to address the depiction of 95th percentile wet and 5th percentile dry versus actual likely or probable events such as multiple wet years, multiple 100-yr storm events, and other real world occurrences.
- The application needs to include a description of how the water balance model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

3.7.3 Water Treatment

"Several treatment processes were evaluated but eliminated from consideration due to high costs or potential ineffectiveness. Biological treatment processes could be used for reducing nitrogen species, but will have limited effectiveness for dissolved metals and would potentially be inhibited at low temperatures. Media-based treatment methods that utilize synthetic or natural (e.g. zeolite) ion exchange media are capable of effectively removing most of the dissolved constituents of concern. However, due to the wide range of contaminants, multiple reactors in series would be required for complete treatment, and regeneration processes would produce large volumes of brine that must be treated or disposed."

- The application needs to further describe the treatment processes considered and the rationale for the treatment methods proposed. For example, biological treatment has been used successfully at other Montana mine sites to treat nitrogen and future treatment at those sites anticipates using both biological treatment and reverse osmosis.

"Each treatment train relies on clarification and filtration to reduce TSS concentrations, and reverse osmosis (RO) with pre-treatment to remove dissolved parameters of concern."

- Information needs to be provided showing examples of successful similar treatment systems with similar contaminant loads, flows and climate.

"The concentrated RO reject will require further management." "Mechanical evaporation, ambient evaporation, and on-site storage of the entire reject volume using temporary tanks was considered but rejected due to uncertain effectiveness and/or prohibitive costs. On-site storage of concentrated brine in the CWP and/or off-site hauling to a disposal well is feasible if the volume of brine can be reduced to low enough levels. To reduce the volume of brine that must be managed during the Construction Phase (as well as the Closure Phase), a VSEP system will be used. VSEP is an RO system that incorporates vibrational shear forces to prevent membrane fouling and maintain high recoveries, thereby effectively treating RO reject streams and reducing the volume of brine that must be managed."

- Additional information needs to be provided addressing the RO reject including:
    - Geoenvironmental characterization of the reject including water chemistry and toxicity,
    - Management alternatives including additional discussion of pros and cons,
    - VSEP system examples

"The preferred brine disposal option is pumping of brine to the paste plant and incorporation of the brine into the cemented tailings for permanent disposal."

- Information needs to be provided showing what influence the various constituents (brine, tailings, and waste rock) would have on CTF seepage geochemistry. Information needs to be provided showing examples of successful similar disposal of brine into cemented tailings.
- Information including pilot testing needs to be done to assess the impact of brine disposal in tailings and its impact on processing due to recycle water containing soluble brine constituents.

3.7.4 Treated Water Disposition

"Tintina plans to dispose of treated water to a surface LAD area during summer months as necessary using traditional Rainbird-type irrigation systems. This type of system was used successfully in 2014 to discharge water generated from 30-day pumping tests. Major components of this method of water disposal will be through evaporation and vegetative uptake."

- The application needs to address to what extent if any LAD will be used to effect "treatment" of water prior to disposal. The application needs to address the component of groundwater infiltration that will occur in LAD. The application needs to provide additional information on LAD operations and the potential for undesirable impacts from SAR and metals accumulation.

3.7.5 Storm Water *3.7.5.1 Design Events*

- The application should provide details and rationale on the selection of return period design criteria for all the water management components during all phases of the Project, including long-term closure. Details should include calculation of the failure probabilities.

3.8.2 Projected Construction and Operational Traffic

- The application should describe the sourcing of primary mine materials, delineating supplies arriving from the local area from those from Montana and elsewhere. Please distinguish between materials such as mine supplies, primary flotation supplies, lubricants, fuels, and lime for cemented tailings.

- The application should include a traffic management plan for routing traffic through White Sulphur Springs and the surrounding area. Details should include:
    - route through White Sulphur Springs;
    - timing of transportation activities (e.g. daily, weekly and monthly restrictions);

  - safety of residents with particular focus given to routes involving children and cross-walks;
  - communication with residents within community; and
  - congestion aversion.

5.0 MITIGATIONS 5.1.1 Failure Modes and Effects Analysis (FMEA)

"Tintina developed a number of these mitigations by searching for ways to reduce risks to human health and the environment, through an examination of the effectiveness of proposed operational processes and examination of facility designs and their modes of failure using a methodology called Failure Mode and Effects Analysis."

- The application should identify whether broad-based stakeholder risk assessment processes, such as failure modes and effects analysis, will be completed and/or whether external expert review panels will be used as internal quality controls to guide the project.
- The application should identify if the FMEA conducted is preliminary and if they plan on conducting additional FMEAs to include broad-based stakeholder participation, including participation by regulatory staff and public interest organizations prior to finalization of project designs.

7.0 RECLAMATION AND CLOSURE 7.1 Introduction

"Temporary closure reclamation will occur if the mine enters into a period of temporary inactivity." "Temporary closure reclamation and site protection will include: stabilizing site-wide drainage facilities, prevention of unnecessary erosion by stabilization and revegetation of any existing disturbances, maintaining site access, provide site security by maintenance of fencing of facilities, protection of equipment, and preparation and implementation of a facility inspection program. All infrastructure required to resume mining will remain in place."

- The application needs to include additional details with regard to temporary or early closure. Details should include:
  - water and solution management and any requirements for water treatment;
  - infrastructure requirements (e.g. ability of tailings facility to accommodate temporary or early closure);
  - identify critical points in the project life cycle where temporary or early closure is most probable and most challenging; and
  - length of time project could remain in temporary closure before discharge would be required.

7.3 Reclamation Schedule

"The long-term closure plan is discussed in greater detail below." "Long-term closure of the site is expected to take approximately 2 to 3 years, excluding successful long-term revegetation establishment and water quality monitoring."

- The application needs to provide more details on the long-term closure of the site relative to revegetation establishment, site operations and maintenance, and water quality monitoring.

- The application needs to provide estimates for the periods for monitoring using conservative considerations for the long-term operational and maintenance requirements for the site.
- The application needs to include an analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks.

"Post-operational monitoring will occur until such time as the mine is certified as fully reclaimed and all bonding release milestones are met, or as determined in the post-operational monitoring program to be developed in conjunction with DEQ."

7.4 Bond Release

"DEQ is responsible for calculating the amount of performance bond for reclamation of the Project. The purpose of the bond is to ensure the fulfillment of obligations under the MMRA and rules implementing MMRA by ensuring the availability of funds sufficient to perform reclamation in the event of default by the operator." "Once the Project is further along in the Application approval process and the document reviewed by DEQ, (all necessary facilities and surface disturbances identified, and a reclamation plan agreed upon) DEQ Hard Rock Section staff will prepare a bond calculation assuming site-wide reclamation and closure plan will be executed by a 3rd party contractor under DEQ supervision."

- The application needs include a reclamation and closure cost estimate indicating the reclamation performance bond and long-term treatment trust fund amounts necessary for this project. In lieu of DEQ calculating the bond the operator can use the Standard Reclamation Cost Estimator (SRCE) model developed by SRK and long-term cost calculations using standard engineering methods. The cost estimate could be clarified as preliminary and based on early information subject to finalization of an actual bond amount by DEQ.

General Comments

- The application needs to include an assessment of the potential effects of climate change on baseline data, predicted source loadings, water balance and receiving water effects.
- APPENDIX Q: Alternatives Analysis for Siting of Major Facilities (pending) – analysis of the application without this critical document is difficult and the application should not be considered to be administratively complete pending its provision. The application needs to include a detailed description and assessment of alternatives to or alternative ways of undertaking the Project with respect to tailings and waste rock management. This alternatives assessment should be comprehensive, provide transparent rationale and give consideration to the following:
    - Full life-cycle costs and all phases of the proposed CTF (i.e. in perpetuity);
    - Risks of the proposed CTF (i.e. as per risk assessment);
    - Potential significant adverse effects of the proposed CTF to environmental values (i.e. wildlife, water and aquatic resources) and socio-economic values (i.e. health, social, heritage and economic);
    - Identification and comparison of best practices and best-available technologies for tailings management;
    - Options for managing water balance to ensure safety and reduce probable risks of structural and/or non-structural CTF failure (i.e. as determined by the risk assessment);

  - Technically-sound engineering solutions that mitigate potential significant adverse effects based on actual site conditions (e.g. groundwater, climate change, construction challenges); and
  - A clear and transparent evaluation of the factors that support the proposed CTF.
- APPENDIX P: Emergency Response Plan. It appears to be just for the exploration decline that was proposed last year, not the full mine plan and does not address transportation spills, pipeline spills, process water spills, etc.