APPENDIX A

Technical Memorandum 1

Technical Memorandum 1

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to increasing the cement content in tailings placed in the impoundment and underground workings

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as "MOP", with the particular section and page numbers as appropriate.

BACKGROUND

PRODUCTION MINE WORKINGS

During mine operations, the production workings (stopes) would be backfilled with cemented tailings, pumped and piped as a paste to final placement. Over the life of the mine, it is expected that the process would place 5.8 million tons (MT) (45percent of total tailings). The stopes would be extracted and then backfilled. The backfill would be pumped in two or more blocks as shown in the MOP (Figures 3-4, 3-5, pp. 145, 146), allowing reasonable handling and complete placement along the horizontal length of each stope. The backfill is pumped to refusal, with complete contact across the sill (floor) and the ribs (walls).

Adjacent stopes are taken only after the fill has set and reached its projected 28-day strength. Typically, this entails a multiple-pass sequence where primary stopes are bounded by virgin ground on both ribs (sides), and secondary stopes have either one or both ribs comprised of previously placed backfill.

In the designed overhand scheme, the stopes are taken from the bottom up. An entire sublevel, or significant amount thereof, is mined and backfilled before mining proceeds in the overlying stopes. The overhand stopes are mined with the working sill (floor) being the previously placed and hardened cemented backfill. When backfilled, the new fill is placed across that subjacent fill, assuring intimate contact and support with no air gap between fill levels.

CEMENTED TAILINGS FACILITY

During mill operations, the cemented tailings facility (CTF) would be filled with both waste rock from the mine development phase and with cemented tailings. The waste rock would be used in the construction of a drain blanket and sump before the tailings are placed. Waste rock also would be used in constructing a vehicle access ramp within the lined basin. In total, approximately 770,000 tons of waste rock would be placed in these areas. Across the life of the mill, a total of 7.1MT of cemented tailings (55 percent of total tailings) would be placed in the CTF.

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-high density polyethylene (HDPE)-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248).

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418).

CURRENT MOP

The proponent proposes to mix thickened tailings with cementitious binder(s) to create cemented tailings paste. The underground paste will be mixed to a 4-percent cement content and pumped to final placement in mined-out stopes. That would entail approximately 232,000 tons of binder across the life of mine. The tailings scheduled for surface placement would be mixed to 0.5 to 2 percent cement content and pumped to final placement in the CTF. That would entail up to another 142,000 tons, for a total of 374,000 tons of binder across the life of the mine.

The variability in cement content is projected to comport to operational requirements at the time, as well as with tailings properties, which may vary depending on ore characteristics. Operational flexibility in cement content is recommended to allow optimizing performance in pumping and final behavior.

The selected cement content ranges are based on the distinct requirements for each final placement area. The cement contents have been developed through extensive bench tests run on exploration samples (MOP, Section 3.3.2.5, pp. 166-168; Section 3.5.9, pp. 205-211). The proposal to continue further testing follows prudent practice for all long-term engineering and construction. That allows changes to accommodate varying ore and tailings characteristics, as well as changes in binder and admixture sources and requirements.

CONSTRUCTION ISSUES

Overall, both paste backfill and paste surface deposition are readily constructible. Tailings in cemented paste systems are common in the mining industry.

Pumpability of the cement paste is critical for the success of this method. A long set or flash time can be critical in maintaining pumpable flow. Low to moderate cement contents are a primary means to achieve pumpability and avoid system upsets. Rheology and strength testing has been conducted to support the selected cement contents.

These investigations include consideration of admixtures of fly ash and/or slag. Typically, these are used to reduce cement requirements, but they also can provide benefits such as improved pumpability and sulfate resistance. Tests of specific materials establish their utility, and the proponent is investigating their suitability and availability. Type C and F fly ash and a suite of possible slag sources are under review.

Chemical retarders can be added during mixing as means of achieving and maintaining pumpability with high cement content. These do lead to process complications, which must function to maintain operability. In addition to increasing costs, the added complexity elevates risks of system upsets.

Normal mine and mill operating practice is to assay and evaluate the tailings for varying chemical characteristics. That will allow adjusting binder, admixtures, and chemical agents to optimize the mix and assure consistent and desirable properties. One aspect is to monitor pyrite to avoid excessive exothermic reactions whether underground or in the CTF (Landriault 2001; Beamish & Theiler 2016).

EIS ENVIRONMENTAL ISSUES

CEMENTED BACKFILL COMMON USAGE

Cemented backfill is a common and proven concept for a wide range of mining methods and applications (CIM 1978; Crandall 1992). It has been used underground in coal, industrial minerals and metal mining for decades, domestically and internationally (Hassani et al. 1989; Stone 2001).

Hydraulic backfill has a long history and is common and proven across a number of commodities and mining methods. The first hydraulic backfill documented was at a coal mine in Shenandoah, Pennsylvania in 1864 (Crandall 1992) with the goal of controlling subsidence beneath a church foundation. The paste fill now common in underground mining is an evolution using modern pump characteristics and material science, with a primary intent to minimize the amount of water required to transport the cemented media.

There are challenges in handling high-sulfur materials, but many base-metal mines are so characterized and have been using mill tailings as the basis or major components of their fill systems (Landriault 2001, Palkovits 2010). It is not expected that the addition of cement to tailings would completely buffer the acid-generating potential of the tailings (Bertrand et al. 2000). That said, the physical contributions of cementing the material minimize infiltration and the release of contained water, contributing overall to positive environmental performance of cemented backfill.

Black Butte Copper tested paste backfill with 2 and 4 percent cement. These are reasonable take-off levels and fit with Carlin-type geologies, where host rocks are characteristically pyrite-rich silty limestone or limey siltstone (Cline et al. 2005). Those tailings are characteristically pyrite-rich, and the backfill mix ranges are reasonably applicable to the Black Butte Copper Project.

In paste, the 20-micron particle size seems to be more critical to performance than binder content, in that an envelope of fines is necessary to assure consistent paste flow (Landriault 2001). That said, binder is important as if it sets too soon – paste does not move rapidly – the entire process halts. Generally, an overhand design does not require the strength of an underhand, and the cut and fill geometry requires only a 16-foot-tall rib rather than the 50- to 150-foot-tall ribs common in long hole open stopping. Suitable rheology – maintaining Bingham or pseudoplastic flow behavior – is a driving goal in paste fill methods. The 30-micron grind of the Black Butte ore would assure sufficient percentage of 20-micron particle size fraction to maintain desired paste flow conditions.

UNDERGROUND-PLACED CEMENTED BACKFILL

Historically, backfill has been primarily a ground control technique to allow safe mining and avoid surface subsidence. Uncemented and cemented fill has been used with the aggregate or ground ranging from mine waste rock, quarried rock, or sand and mill tailings. Coarse-grained fill typically is transported by haul trucks and worked to final placement with construction or mining equipment. Fine-grained fill typically is transported either by transit mixers or through pipelines, using boreholes where applicable.

In recent decades, the use of mill tailings has become more common as a full-circle means for disposing them underground rather than in typically large surface tailing impoundments. A given volume of rock or soil expands when fragmented through excavation. Due to the increase in void ratio, commonly termed “swell” (USBM 1968), not all the tailings can be returned to the original underground space, and a third or more of the mass will require storage elsewhere.

The proposed Black Butte Copper Project appears to combine the best of both these proven techniques. The ore, now processed to cemented tailings, would be returned underground. The balance of tailings that would not fit underground would be cemented and placed in a modern environmental containment facility. Like the underground fraction, the solidification would render the mass relatively inert chemically as compared to uncemented tailings. Being cemented, the tailings would behave mechanically as a rock formation rather than a substantially saturated soil mass.

SURFACE-PLACED CEMENTED TAILINGS

Though some mineral assemblages in some tailings are cementitious, mixing cement into tailings prior to surface storage is a relatively new and still-innovative technique. It follows logically from the mechanical and environmental benefits of dry-stacked and subaerially-deposited tailings. Those techniques use dewatering and densification to increase the mechanical qualities of tailings while reclaiming significant amounts of tailwater for recycling into the milling process.

The mechanical quality improvements essentially include increasing cohesion and friction angle with a commensurate increase in resistance to seismicity, with or without impounding embankments.

With the adoption of common concrete mixing equipment to the tailings handling process, the proposed CTF would further extend the reliability and robust nature of both operational placement and long-term storage of the tailings. Rather than storing a mass that may be subject to liquefaction, the CTF would hold a solid cement mass.

During operation, the susceptibility of the placed and set cement to both water infiltration and release of contained moisture would be lower than uncemented tailings. Since the contained moisture potentially would carry metals and salts, the cementation provides a desirable environmental benefit in chemical as well as mechanical terms.

The CTF would have a composite underliner during operation. During the closure phase, a composite overliner would be added and welded to the underliner where the liners meet along the perimeter of the facility. These robust containment systems further protect the environment from a solid mass of concrete, which would have minimal water available for release.

POTENTIAL DEGRADATION OF CEMENTED MATERIAL – WATER QUALITY CONSEQUENCES

Sulfate Attack

Sulfate attack is an expected form of degradation given the tailings mineralogy. Sulfate attack generally presents as either external or internal (DePuy 1994). External is when sulfates originate from groundwater or are leached from soils. Internal is when sulfates are present in the aggregate (i.e. tailings), or sulfates dissolve in the mix water, additives, and admixtures. The predominant form of sulfate attack on the tailings is internal.

The cemented backfill is not expected to deteriorate hydrologically or structurally under anoxic conditions. The fill would not be exposed to cyclical wetting and drying, which induce repeated sulfate attacks progressing to significant deterioration. Those cycles typically are associated with conventional construction of infrastructure and buildings, with surface and meteoric phenomenon being the principal setting.

Further, due to the sequential construction (local geometry) and overall geometry, the cemented backfill would be physically constrained from expansion, thus minimizing cracking.

The cemented tailings deposited in the CTF are not expected to deteriorate significantly. Due to the essentially continuous layered flow of cemented paste into the CTF, repeated wetting and drying cycles would be localized in the area and few in number. Due to its own mass and confinement of the lower portion, significant crack propagation from deterioration is not expected within the CTF mass. Coupled with its operational liner and closure encapsulation, groundwater degradation is not expected.

Whether potential sulfate attack is external or internal in each setting (i.e., underground fill or surface CTF), there are established tests and procedures for estimating and evaluating performance (DePuy 1994; MOP Section 3.5.9.3, p. 206). Not all cracking is deleterious, as some reaction products simply fill the cracks, retaining hydrologic and even structural integrity. By the same token, in both settings potential reduction of structural strength from sulfate attack is not a system failure. The underground cemented tailings would remain substantially incompressible and a strength reduction would not induce failure of surrounding rock into the backfill mass. The surface cemented tailings would be fully contained within the CTF basin and require little structural integrity. The embankment stability analyses are acceptable during construction, operation, and closure, considering a full floodwater pool during the final two phases (MOP, Section 3.5.5.4, pp. 192-194).

The waste rock (MOP, Section 2.4.2.2, pp. 80-81) will be encapsulated within cemented tailings in the CTF to remove that material from potential degradation of water quality.

Arsenic Mobilization versus Cement Content

The underground cement content of 4 percent is not expected to significantly offset the pyrite contents, which are expected to be consistently much higher in the tailings. Thus, it is not expected that the cement content would drive the pH into ranges where arsenic mobilization is significantly increased (Zaman 1985). If local (small quantity) underground construction-grade concrete or grout – both requiring high cement content – is planned using tailings as the aggregate, numerous analyses provide guidance in treatment of arsenic (Reddy and Ramachandran 2005).

CONCLUSIONS AND RECOMMENDATIONS

PROPONENT PROPOSES APPLICATION OF PROVEN TECHNOLOGY

Cemented backfill is a proven and common technology in underground mining. The extension to a CTF on the surface is practical, logical, and combines positive elements of underground and surface tailings management practices. To date, the testing regimen supports the selected cement content levels and does not indicate a need for or benefit from increased cement contents.

CONFIRM BMPS

The proponent presented best management practices (BMPs) throughout the MOP as benchmarks for design and operation. BMPs proposed for the use of cemented backfill include geological engineering analyses, hydrologic modeling, ongoing material property testing, and diligent monitoring to confirm closure with design assumptions, compliance standards, and goals.

REVIEW SYSTEM OPTIMIZATION POTENTIALS

Varying Ore Characteristics

The ore, and subsequently tailings, are expected to vary between and within the Upper and Lower Zones. Diligent sampling and process controls optimize copper recovery. These include tailings analyses, which can then be used to optimize cemented tailings preparation and handling. Rapid sample turnaround can inform mix arrangements and fill scheduling. Treating backfill and tailings management as fundamental aspects of mine and mill management, which they are, go a long way toward optimizing both short- and long-term mining and milling processes.

Available Binder Media

The proponent has identified a number of sources for available binder media. With standard tests and comparisons, the possible sources can be characterized, ranked, and selected with confidence. Both short- and long-term behavior can be incorporated in the selection process, with possible distinctions between underground and surface applications. It is prudent to initiate selection based on drill hole samples, but contingent (6 months) or conventional (1 year) selections can be developed with actual milling experience.

In these discussions, admixes such as fly ash and slag must be considered. In addition to potential cost reductions, these materials may improve performance under short- and/or long-term sulfate attack and other phenomenon characteristic to mine backfill and tailings storage applications.

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APPENDIX B

Technical Memorandum 2

Technical Memorandum 2

To:	Montana Department of Environmental Quality
From:	Environmental Resources Management
Date:	December 29, 2017
Subject:	Black Butte Copper Project - Whether there is an advantage to constructing the CTF so that the entire facility is above the water table

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as "MOP", with the particular section and page numbers as appropriate.

BACKGROUND

CEMENTED TAILINGS FACILITY

During mill operations, the cemented tailings facility (CTF) would be filled with both waste rock from the mine development phase and with cemented tailings. The waste rock would be used in the construction of a drain blanket and sump before the tailings are placed. Waste rock also would be used in constructing a vehicle access ramp within the lined basin. In total, approximately 770,000 tons of waste rock would be placed in these areas. Across the life of the mill, a total of 7.1 million tons of cemented tailings (55 percent of total tailings) would be placed in the CTF.

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-high density polyethylene (HDPE)-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248).

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418).

PRE-CONSTRUCTION GROUNDWATER TABLE

The pre-construction groundwater table ranges from 31 feet (9.5 meters) above the CTF base elevation on the west side of the impoundment to 6 feet (2 meters) below on the east side (MOP Figure 2.8, p. 50; Figure 3.36, p. 254).

CURRENT MOP

COMPOSITE-LINED FACILITY (EARTHEN AND SYNTHETIC COMPONENTS)

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-HDPE-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248). All of these components, foundation drains through drainage layer are best available technology (BAT) and best management practice (BMP) features with proven success in mining, municipal waste handling, and other industrial applications.

COMPOSITE-CAPPED FACILITY (EARTHEN AND SYNTHETIC COMPONENTS)

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418). The excess fill, subsoil, and topsoil would provide long-term freeze-thaw protection, limit infiltration to the HPDE liner, and provide natural growth media for vegetation, reducing erosion.

CONSTRUCTION ISSUES

CONVENTIONAL CONSTRUCTION METHODS

The proposed foundation drains and overall CTF entail conventional contemporary construction methods in a canyon-fill setting. There is essentially one embankment (east side) and minimal footprint. The cut and fill balance and overall siting have been selected to provide construction materials for the CTF and other surface facilities throughout the Project.

CONSTRUCTION-PHASE PROTECTION OF SYNTHETIC LINERS

The engineered fill protective layers are intended to avoid synthetic liner penetration due to construction and early stage filling operations. The fill suitability (angularity, gradation) must be confirmed to avoid damaging the synthetic media. Also, application must consider low-ground-pressure (LGP) equipment (wide-track small dozers or telescoping stacking conveyors on LGP crawlers) for placement of the protective layers (MOP Section 3.6.8.7; Section 3.6.8.8, p. 255; Section 3.6.8.10, p. 259). The bottom protective layer must not be rutted prior to receiving the synthetic liners. The upper protective layer must be thick enough to minimize stress transmittal by vehicles and machinery to the upper synthetic liners.

In the upper closure cap, care must be taken that potential liner bridges or penetrations are properly handled. Ruts, gullies, or ledges in the hardened cemented tailings must be reduced to smooth non-bridging or non-penetrating features. Alternatively, they can be covered with select fill to prevent either bridging or penetration.

The detailed construction specifications and steps must be clear and well-monitored to assure the synthetic liners would not be compromised during construction (Peggs 2003).

Elevating the CTF Above the Water Table Throughout

This construction issue:

- Enlarges CTF footprint;
- Increases CTF material import requirements (alters cut/fill material balance); and
- Triples (or more) the number of embankments, with concomitant seismic risk.

These three items are intertwined and addressed together in the following discussion.

Footprint enlargement is direct and indirect. Direct is in the footprint expansion of the CTF itself. Essentially, with a 2.5:1 slope, for every foot of elevation increase, the footprint extends outward 2.5 feet. To retain the same basin take-off point, the embankment centerline also moves outward so the downstream or out slope enlargement becomes 5 feet per vertical foot.

Indirect is the footprint expansion by relocating the associated structures to accommodate an enlarged or even relocated CTF. The associated structures would include but not be limited to the Process Water Pond (PWP), the reclamation materials stockpile, and the subsoil stockpile and their access roads.

By inspection (MOP Figure 3.34, p. 249), elevating the CTF as little as ten feet would dramatically enlarge the eastern embankment and entail sufficient fill along the north and south to form distinct embankment faces in those areas. In addition to presenting additional faces, that enlargement requires two out slope convex corners, which are not recommended geological engineering features (slope stability) for earthwork embankments.

Increasing the embankment size to raise the CTF above the water table would dramatically alter the cut/fill balance, requiring the import of engineered fill from offsite.

Alternatively, the eastern embankment could be constructed in a continuous or near-continuous out slope convex arc, but that shape simply extends the non-recommended convex feature.

If a 30-foot elevation increase is considered, the required embankments would be considerably larger than the selected siting. That embankment size could be somewhat reduced by sloping the basin floor to more closely follow the existing topography. Even with that, placing a solid cemented mass in a canyon mimics a wedge shape, which is a classic geological engineering failure analysis. Any tendency to slide would have to be analyzed, with conceptual potential remedies entailing keys (footings), which might in turn intercept the water table.

EIS ENVIRONMENTAL ISSUES

Perched or Regional Groundwater

It reasonably could be expected that the water table intercept would be of a small perched aquifer, which may drain during the construction phase. Whether perched or part of the local regional aquifers, the intercept would direct remaining water (upgradient of the intercept) into the foundation drains or otherwise downgradient beneath the CTF. In either case, the ultimate disposition would remain in the regional groundwater system, analogous to surface runoff diversions.

GROUNDWATER MOUNDING

Prior to insisting on an elevated CTF, it is appropriate to investigate whether groundwater mounding would occur. If so, elevating may have no benefit, as the result of mounding might simply replicate the interception now expected.

WETLAND IMPACTS

On inspection, elevating the CTF would expand its footprint. A rigorous evaluation would be necessary to gauge the extent of impact into wetlands below the CTF, but the facilities site plan (MOP Figure 1.3, p. 9) shows that any increase in downstream footprint immediately impacts wetlands. If the nearby facilities (especially the PWP, but potentially the reclamation materials stockpile and subsoil stockpile) must be moved, there is a much greater chance of impacting wetlands beyond the selected siting.

It bears stressing that a part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276).

VISUAL IMPACT

The visual impact would expand as the CTF increases in elevation, with concomitant embankment extension downslope to the North, East, and South. A lift of ten feet would be marginally more visible from Sheep Creek Road. A lift of 30 feet would be visible from portions of US 89.

GRANODIORITE SOURCING

In design and construction, the quality of the engineered fill is as important as the quantity. A principal focus of the CTF excavation is to access the chemically inert granodiorite, which is a critical component in the construction of the drainage blankets for the CTF and the PWP, as well as other structures of the surface facilities (MOP Section 3.6.8.10, p. 259).

A similar mechanically robust and chemically inert rock could be located, quarried, transported, stockpiled, and used in constructing the larger facility associated with elevating the CTF. That would increase the environmental impact far offsite (quarrying) and between sites (transportation) in addition to the local footprint increase.

SINGLE VERSUS TWO-PHASE CONSTRUCTION AND FILLING

With or without an expanded footprint, the query has been raised as to whether there is a benefit to constructing the CTF in one layer or phase. In a broadened facility, that conceivably could be done in one layer.

The phased CTF construction conforms to the mill schedule while minimizing liner exposure across the mine life (MOP Section 3.6.8.9, pp. 256-258). Among other construction efficiencies, it allows handling the tailings pipe spigots with close access during the early years of guiding and forming the cemented tailings deposition. Staging embankment construction also is a common technique to minimize the exposure time of both embankment faces (internal/external) to possible seismic activity.

A common driving practicality is that phased construction of these large earthwork structures is less disruptive in all aspects of heavy construction – workforce, equipment, construction materials, transportation, and support services (lodging, fuel, etc.).

TECHNICAL APPROACH

CONFIRM/PREPARE A TRADE-OFF STUDY OF PROPOSED AND ELEVATED IMPOUNDMENTS

A rigorous part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276; MOP Appendix Q). There is no need to replicate those efforts, which in any event cannot be done within the scope of this memo.

The primary object of considering elevating the CTF is to avoid impacting the local water table. Evaluating the water table impact would likely address the detailed nature (perched or regional) of the water table, and whether mounding would occur. The evaluations would likely address if either the original intercept or interception of a mounded water table would be deleterious.

If a groundwater analysis indicates a deleterious condition, a cursory trade-off could be initiated based on the following investigations:

- Constructability
- Operability
- Long-term performance

The environmental issues presented above also could be folded into this trade-off analysis. Conventional weighting and ranking methods could be a relatively simple way to organize and evaluate the options, whether rigorous financial costs and benefits are included.

CONCLUSIONS AND RECOMMENDATIONS

Cemented tailings have become common for underground backfill, and the surface deposition of cemented tailings within a lined basin is a combination of the best of underground and surface tailings storage techniques.

Essentially, the groundwater intercepted by the CTF would be diverted beneath the composite liner system and/or captured by the foundation drains. In both cases, these are diversions, not removals from or degradations to the overall water system. In that regard, the groundwater diversion should be considered in the same regard as surface water diversions – spatial and temporal handling of water to the overall benefit of the system and environment. Any negative effects would be *de minimus* and significantly outweighed by the conservation and protection aspects of diversion. As such, there is no conceptual benefit to elevating the CTF above the groundwater table. Given the items addressed in this technical memo, it reasonably is expected that any ranking of current proposal versus elevated configurations would not favor the elevated configurations.

PROPONENT PROPOSES APPLICATION OF PROVEN TECHNOLOGY

From the alternate site analyses through the specifics of foundation drain and liner design, the proponent has achieved BAT and BMP goals. The liner construction details noted above should be incorporated into the design and construction of the facility(ies). With that, there would be a reasonable expectation that execution of the construction and operating phases would bring those goals to safe and productive reality.

DETERMINE WHETHER RE-SITING IMPROVES OR WORSENS ANY ENVIRONMENTAL IMPACT

Three of the four analyzed CTF sites were less favorable than the selected location and configuration. The selection is a culmination of direct and indirect aspects relating to impoundment size through wetlands and visual impacts. The presented configuration is optimal and re-siting would worsen the environmental impact.

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APPENDIX C

Technical Memorandum 3

Technical Memorandum 3

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 21, 2017

Subject: Black Butte Copper Project - Full Sulfide Separation Prior to Tailings Disposal

BACKGROUND

Tintina Resources, Inc. is the owner of the Black Butte Copper Project (the Project), a proposed underground copper mine located approximately 15 miles north of White Sulfur Springs in Meagher County, Montana. The project is currently in the permitting phase and a Mine Operating Permit Application was submitted to the Montana DEQ's Hard Rock Bureau in July 14, 2017 (Tintina Montana, Inc. 2017). A number of tailings management alternatives were evaluated by a large working group of scientists and engineers to decide on the best approach (Geomin Resources 2016). Further assessment of the depyritized tailings approach is specifically warranted.

Montana DEQ has requested that Environmental Resources Management (ERM) assess the feasibility of using the flotation/separation process to remove all sulfide minerals from the tailings prior to disposal. Both raw and cemented paste tailings were assessed under subaqueous and subaerial weathering conditions in laboratory tests as part of a baseline geochemical evaluation for the Project. Static and kinetic testing indicated the potential for acid generation in both the raw and the cemented paste tailings. Kinetic testing indicated elevated sulfate and metals concentrations in leachate, including exceedances of groundwater standards for arsenic (As), nickel (Ni), and thallium (Tl).

Sulfide-S composition was 17.7 to 29.9 percent in raw tailings and 21.6 to 21.9 percent in paste tailings. Pyrite was a primary mineral constituent in tailings. Stripping out sufficient pyrite to render the rest of the tailings mass non-acid-generating would be technically challenging and yield large volumes of pyrite concentrate. Stripping out sulfide minerals creates a more hazardous waste than tailings; while being smaller than the original tailings, the volume of the depyritized tailings is substantive and poses a challenge for disposal and long-term storage. In addition, the use of acid is required for depyritizing of tailings, which comes with associated costs (Benzaazoua and Kongolo 2003; Bois et al. 2004).

CURRENT MOP

Feasible alternatives for tailings management and storage were evaluated (Appendix Q to the MOP; Geomin Resources 2016). Cemented paste tailings using 0.5 to 2 percent cement was selected as the preferred management method in an impoundment (cemented tailings facility [CTF]) located just south of the mill site. The current MOP does not propose to remove non-ore sulfide materials from the tailings prior to disposal.

In the Tailings Management Alternatives Evaluation (Appendix Q to the MOP), two alternatives involving depyritized tailings were considered:

1. Depyritized ultra-thickened subaqueous tailings deposition; and
2. Two-cell ultra-thickened depyritized tailings and pyrite concentrate.

These two alternatives received the lowest score in the Tailings Management Method Alternatives Working Group Rankings.

Key challenges associated with depyritization included the following:

- The need to adjust the pH of the process downward for pyrite flotation, followed by further pH adjustment for copper flotation, increasing lime consumption and issues in the pyrite circuit operation.
- Higher chemical consumption, which also increases:
  - Cost and complexity of flotation;
  - Tracking materials held onsite;
  - Transportation logistics; and
  - Potential for spills/leaks/errors in handling.
- The requirement for an additional circuit in the mill.
- The need for additional mining to provide sufficient space for underground disposal of the pyrite concentrate. More waste rock would result from this additional mining.

EIS ENVIRONMENTAL ISSUES

IMPACT OF NOT REMOVING SULFIDE MINERALS FROM TAILINGS PRIOR TO DISPOSAL

Potential for Acid Generation

Tailings that have not been stripped of their sulfide minerals have a higher acid potential (AP) compared to depyritized tailings. As a result, the requirement for capture and treatment of tailings seepage becomes necessary at the surface. Underground backfill has a lower potential to impact groundwater if it is adequately sealed and less permeable to groundwater flow as saturated conditions develop.

Higher Source of Acid Potential

Sulfide minerals typically represent the largest source of acid generated at mine sites. The oxidation of sulfide minerals in the presence of water is responsible for the generation of sulfuric acid. A simplified reaction for the oxidation of pyrite is as follows:

$$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 16H^+ + 8SO_4^{2-}$$

Where: Fe = iron; S = sulfur; O = oxygen; H = hydrogen

It is assumed that two moles of acid will be produced for each mole of sulfur. The AP is calculated by multiplying the percent of total sulfur or sulfide sulfur in a sample by a conversion factor (AP = 31.25 * %S). Units for AP are kilograms (kg) $CaCO_3$ /t (EPA 1994; INAP 2009; Price 2009; Sobek et al. 1978), where Ca = calcium and C = carbon.

AP in rock or tailings samples are potentially offset by minerals providing neutralization potential (NP). Units for NP are kg $CaCO_3$ /t. The acid rock drainage (ARD) potential of a sample is determined by acid-base accounting (ABA), where NP/AP less than or equal to 1 is considered potentially acid generating (PAG), NP/AP greater than 1 and less than or equal to 2 has an uncertain acid-generating potential, and NP/AP greater than 2 is not PAG (nPAG) (INAP 2009; Price 2009). The ratio of NP/AP is often referred to as the net potential ratio. Clearly, not removing pyrite from a sample renders it with a higher AP compared to a sample that has been depyritized.

Environmental Management

Management practices considered at the Project if pyrite was not removed from the tailings are described in Appendix Q of the MOP and include:

1. Conventional tailings slurry deposition;
2. Dry stack tailings;
3. Paste tailings with underground paste cement content (approximately 4 percent); and
4. Paste tailings with underground reduced paste cement content (approximately 2 percent).

The pros and cons of each option are summarized in Appendix A of this memo and represent the results of the tailings management alternatives evaluation (Geomin Resources 2016).

The preferred management option selected by the working group was the cemented paste tailings using 0.5 to 2 percent cement in an impoundment (CTF). This method was preferred since the potential environmental impacts would be minimized (e.g., facility stability, environmental risk, and impacts to wetlands). The paste tailings method using reduced 0.5 to 2 percent cement was recognized to have the lowest impact to nearby designated wetlands in terms of total disturbed area. The impact to the wetlands is described in Appendix K of the MOP application. Furthermore, the CTF location alternative is associated with the smallest catchment area footprint. Despite the markedly higher total cost of paste tailings disposal relative to other evaluated methods, the cemented tailings paste and CTF site location were selected as the preferred alternatives.

IMPACT OF DEPYRITIZATION PROCESS AND DISPOSAL OF SULFIDIC BYPRODUCT

The removal of the sulfide minerals from a PAG tailings sample yields two products: (1) refined nPAG tailings, and (2) PAG tailings with much higher sulfide content compared to the original tailings sample. The amount of sulfidic byproduct is less than the total amount of the original tailings material; therefore, the required capacity for disposal is lower (Bois et al. 2004). An added benefit of removing sulfide minerals from tailings is that the depyritized tailings product is nPAG and fine grained with a high surface area to volume ratio. This makes for useful cover material overtop of PAG waste rock/tailings because the depyritized tailings do not generate acid, and will limit the ingress of water and oxygen to the material underneath; this is particularly true if applied as a cover with capillary barrier effects (CCBE) (Bussiere and Aubertin 1999).

Environmental Management

Management practices considered at the Project if pyrite was removed from the tailings are described in Appendix Q of the MOP and include:

1. De-pyritized and ultra-thickened subaqueous tailings deposition; and
2. Two-cell ultra-thickened depyritized tailings and pyrite concentrate.

The pros and cons of each option including those not removing pyrite from the tailings are summarized in Appendix A of this memo and represent the results of the tailings management alternatives evaluation (Geomin Resources 2016). Despite there being some clear environmental advantages to removing pyrite from tailings, these two tailings management options were ranked lowest by the working group in the alternatives evaluation. The associated costs of pyrite removal with current technology and additional costs related to handling and disposal for long-term storage weighed in heavily on the working group's rankings, although practical limitations were also considered.

TECHNICAL APPROACH

DE-PYRITIZED TAILINGS

The technical approach under investigation is the use of a flotation/separation process to remove all sulfide minerals from the tailings prior to disposal. While the de-pyritized tailings represent a relatively benign waste product from an ARD perspective, the concentrated pyrite product has a much higher potential for acid generation compared to the original tailings material. Therefore, disposal options have to be considered for this technical approach.

Case Histories

Several cases exist where sulfide removal was applied as a tailings management practice. Six are listed below and are summarized briefly in the following subsections for context:

- Strathcona Mine, Ontario, Canada
- Musselwhite Mine, Ontario, Canada
- Detour Lake Mine, Ontario, Canada
- Kemess Mine, British Columbia, Canada
- KSM, British Columbia, Canada
- Thompson Creek Mine, Idaho, USA
- Aitik Copper Mine, Sweden

Strathcona Mine, Ontario, Canada

Low-sulfur (less than 1 percent) scavenger tailings combined with lime kiln dust or reject material from lime production were used to cover the high-sulfur (30 percent) tailings at the Strathcona tailings facility near Sudbury, Ontario. The low-sulfur tailings cover was produced as the cyclone overflow from the scavenger flotation units that generate a sandy material for mine backfill. The overflow contains a fine-grained fraction and therefore has the value-added property of moisture retention capacity and reduction of oxygen ingress. The minimum thickness of the cover is 1.5 meters, which is considered sufficient for moisture retention in the lower zone of the cover layer. The area of high-sulfur tailings exposed to the atmosphere, and therefore oxidation, was reduced by at least 50 percent since the cover was applied.

Musselwhite Mine, Ontario, Canada

A pilot study was carried out to assess the suitability of froth flotation for desulfurization of reactive mine tailings at the Musselwhite Mine in Northern Ontario to prevent acid mine drainage (AMD). The effects of operating conditions such as froth depth, air flow rate, impeller speed, and pulp density on desulfurization of Musselwhite tailings were investigated. Results indicated that all of these parameters have effects on the flotation kinetics, recovery of sulfur, and concentrate grade. The most important operating parameters were identified as the air flow rate and froth depth. Environmental desulfurization was demonstrated to be technically feasible for Musselwhite tailings. Based on the data presented for the Musselwhite tailings, the maximum recovery of total sulfur was achieved when the operational parameters were set to the froth depth of 5 centimeters, air flow rate 125 liters per minute, impeller speed 1300 revolutions per minute, and pulp density 35 percent. Under these conditions, the froth flotation produced a satisfactory NP/AP ratio within 12 minutes.

Detour Lake Mine, Ontario, Canada

A single-layer desulfurized tailings cover 1 to 1.5 meters thick was installed over the Detour Lake mine tailings facility. The material was unlikely to produce acidity, and retained oxygen consumption potential. However, the cover materials were coarser grained than originally designed and were confirmed to desaturate in some locations. The cover material was intended to compose of finer material than the tailings, which would create a capillary barrier, high saturation, and low oxygen diffusion. Regardless, near-neutral pH conditions were recorded at the Detour Lake facility.

Kemess Mine, British Columbia, Canada

The Kemess gold mine in north-central British Columbia contains one of the largest earth filled dam structures for tailings storage. In order to meet engineering and regulatory requirements the original construction design called for a 1-kilometer-wide rock dam made with 30 million tons (MT) of non-acid generating waste rock. Instead, the dam was built from suitable quality tailings sand as a cost saving measure. The tailings sand was subjected to cycloning and flotation to reduce pyrite concentration and meet the neutralizing potential ratio specifications for dam construction. Grain size of the sand had to be consistent with less than 15 percent passing through 200 mesh sieve (75 micrometers). In addition to environmental benefits, the economic benefits of using cycloned sands for dam construction include lower dam height and reduced construction costs.

KSM, British Columbia, Canada

Depyritization of tailings is planned for the KSM project in British Columbia with Seabridge having already received permits (September 2014) authorizing early-stage construction activities at the Mine Site and Tailings Management Facility (TMF). The Treaty Process Plant will produce two tailing streams: the bulk rougher flotation tailing representing approximately 90 percent of the ore and a fine, sulfide-rich cleaner tailing comprising the remaining 10 percent. The sulfide stream will be cyanide leached using the carbon in leach (CIL) method followed by processing for gold recovery. A two-stage cyanide destruction circuit is proposed, using the Inco sulfur dioxide process followed by hydrogen peroxide treatment.

Cyclone sand produced from the KSM tailing was deemed suitable for construction material in the TMF. The flotation tailing is classified as nPAG and will be cycloned to produce sand fill for construction of the tailing dams during the summer months. The CIL residue tailing is classified as PAG. This material will be deposited under water in the CIL Residue Storage Cell in the center of the TMF and kept saturated to mitigate the onset of acid generation.

Thompson Creek Mine, Idaho, USA

Desulfurized tailings were produced at the Thompson Creek mine in Idaho for use as covers and in reclamation. ARD from these facilities is not an issue since the sulfide mineral content was removed and the pyrite concentrate was disposed in an offsite location.

Aitik Copper Mine, Sweden

The use of desulfurized tailings as a cover material was investigated at the Aitik Copper mine in Sweden. After desulfurization, the pyrite-depleted tailings can be used to cover water saturated tailings with higher pyrite content, and the pyrite enriched tailings have to be disposed of separately under an engineered dry cover or water cover. The thickness of the depyritized tailings cover is predicted to be 15 to 20 meters. Flotation pilot test results indicate that there is difficulty achieving the target limit less than 0.3 percent sulfides, if only flotation is used in depyritization. The problem is associated with the concurrent presence of both magnetite and pyrrhotite in the tailings, in addition to pyrite. A combination of flotation and magnetic separation has been suggested as a solution.

Environmental Impact

There is a potential for a reduced environmental impact by removing pyrite from tailings (i.e., depyritization) as a method to control AMD. In depyritization, the acid forming sulfide mineral fraction (i.e., pyrite) is either partly of fully separated from the tailings by froth flotation prior to final deposition into the tailings storage facility (Bois et al. 2004).

In complete desulfurization, all tailings are desulfurized by froth flotation. As a result of the separation, an acid generating high sulfur fraction with a reduced volume and a high volume of nPAG low sulfur fraction are formed. Low sulfur nPAG tailings do not represent a long-term liability, which is the most important advantage of the method (Bois et al. 2004).

Partial desulfurization represents the tailings fraction that is desulfurized only during a few years period prior to mine closure. nPAG tailings can be used as an inert dry cover material over top of acid generating tailings. The layer of 1 to 2 meters of desulfurized material acts as an elevated water table and keeps sulfide rich tailings saturated. The saturation of tailings is accompanied by the formation of an oxygen barrier, thus limiting oxygen diffusion to the underlying PAG tailings (Bois et al. 2004).

Storage or Disposal Options

Separation of sulfide minerals generates a small volume of sulfide-rich concentrate and a large stream of tailings with low sulfur content. The two streams can be handled differently. The low sulfur content tailings are relatively non-reactive and do not require as comprehensive decommissioning measures and can be deposited in large-volume repositories, or alternatively used for construction purposes (e.g., cover material, dams, roads, etc.). The sulfide-rich concentrate could be stored underwater in a tailings pond covered with depyritized tailings in a surface facility, or stored underground as paste backfill (Benzaazoua and Kongolo 2003; Sjoberg Dobchuck et al. 2003; Bois et al. 2004; INAP 2009). The most commonly used additive for paste backfill is a pozzolanic binder (e.g., cement, slag, fly ash). These provide significant strength underground at addition levels of 3 to 6 percent by weight. Cement addition also serves to increase the NP, raise the pH, and potentially immobilize metals by mineral precipitation. Other additives include specialty chemicals, resins, and surfactants that can enhance metal adsorption, as well as organic carbon and bacteria to aid biofixation (Newman et al. 2001). The pyrite concentrate would require more cement to raise NP compared to the currently proposed tailings disposal alternative. However, the risk of oxidation is typically limited to a thin upper layer.

Costs

The use of depyritization can reduce reclamation costs at a mine site due to the reduced transportation and material costs. Low sulfur tailings can potentially be used as cover material, which reduces transportation costs if the cover material has to be sourced from offsite. The costs of separating the sulfide minerals from the tailings can be high. The viability of the method depends on the amount of sulfide minerals that have to be removed because negative cost impacts are generated if the sulfide content is too high.

Site-specific conditions and scale of waste also influence how tailings are managed. Partial depyritization can generate cost savings if the tailings pond is located in a flat topography site with a soft base, as the costs for dam construction in these cases are typically high. The operational costs for partial depyritization are lower because only a fraction of the tailings is treated. Complete depyritization of tailings is economically viable if the construction of low permeability tailings dams becomes expensive (Bois et al. 2004).

CONCLUSIONS AND RECOMMENDATIONS

In spite of the environmental advantages associated with depyritized tailings, depyritization was not selected as the best tailings management strategy for the Project. Depyritization of tailings generates a larger volume of nPAG tailings and smaller fraction of PAG concentrated sulfides; however, the management costs of the PAG concentrated sulfides remain too high to be considered feasible compared to other alternatives. These alternatives also pose a number of technical challenges that includes the requirement for large amounts of acid in the processing (which increases lime consumption and potentially poses issues to the pyrite circuit operation due to scaling), and the need for an additional circuit in the mill, which presents a risk to copper recovery. It was also suggested that additional mining of host rock would be necessary to provide sufficient storage space for the underground pyrite disposal. Ultimately, the technical challenges and costs associated with these alternatives resulted in the working group’s low ranking in the tailings management alternatives evaluation.

The preferred management option selected by the working group was the cemented paste tailings using 0.5 to 2 percent cement in an impoundment – a CTF located just south of the mill site. Approximately 45 percent of the total tailings or 5.8 MT would be returned back underground as paste backfill in the mine workings. The claim for selecting this option was that the potential environmental impacts would be minimized. Compared to the depyritized tailings alternatives, there would be less impact to wetlands in terms of total disturbed area. The impact to wetlands is described in Appendix K of the MOP application. The potential for oxidation on the surface of the impoundment materials during the time a deposit lift is laid down prior to depositing the next layer was identified as a risk. However, the group dismissed this concern using the rationale that acidification would be decelerated by the cement to the point of preventing acidic conditions from developing before the next lift is deposited.

It is recommended that more consideration be given to technical feasibility and the pros/cons of the various tailings management alternatives rather than cost feasibility. Based on the material presented in the MOP, it is not clear how much more underground volume would be needed to dispose of the concentrated pyrite fraction if the tailings were subject to pyrite removal. The requirement for a tailings disposal facility at the surface was not eliminated in any of the alternatives presented. The nPAG tailings fraction would provide a useful source of cover material for any of the surface facility designs considered for storage of PAG tailings. There appears to be an increasing number of success stories for the application of desulfurized/depyritized tailings material as a clean cover component of a CCBE.

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Technical Memorandum 3: Appendix A

Table 1. Method Alternative Matrix

Method Alternative	Pros	Cons
1 Whole Tailings Slurry Deposition (subaqueous disposal)	Proven method for controlling acid rock drainage (ARD)	Requires pond management
	Flexible to take paste when it is not needed	Does not provide for pyrite recovery
	Water storage capacity	Tailings could acidify if they dry
	Lower cost	Largest embankment
	Simplicity	Long-term monitoring
2 Dry Stack Tailings	Can be located on slopes/uplands away from wetlands	Air quality issues
	Reduced site footprint	Higher capital costs
	Reduced water treatment costs	Higher operating costs
	Provides for segmented closure/reclamation	Complex operating plan
	No additional access roads required	Requires 4 full-time equivalents
		Requires Process Water Pond (PWP)
		Requires storage of contaminated process water
3 De-pyritized and ultra-thickened subaqueous tailings	Placing pyrite back underground	Storing waste rock for closure
	Established tailings management methods for safety purposes and environmental risk	Cost of pyrite removal
		Uses more functional wetlands
		Requires road relocation
		Potential for tailings seepage

Method Alternative	Pros	Cons
4 Thickened de-pyritized tailings and pyrite concentrate in two cells	No large pond required	Complicated process
	Requires less make-up water	Depends on pyrite flotation and removal at closure
	Removes ARD potential following closure	Requires storage of contaminated process water
	Pyrite separation	Run-off management
5 Paste Tailings - Cement content 4% same as underground paste	Non-flowing tailings	Requires road relocation
	Reduced embankment construction costs	Higher construction costs
	Reduced dust potential	Higher operating costs
	Reduced water loss to evaporation	Higher process and storm water costs
	Limits short-term ARD potential	
	Facilitates placement of closure cover	
6 Paste Tailings - Reduced cement content (2%)	Non-flowing tailings	Requires road relocation
	Reduced embankment construction costs	Higher construction costs
	Reduced dust potential	Higher operating costs
	Reduced water loss to evaporation	Higher process and storm water costs
	Limits short-term ARD potential	
	Facilitates placement of closure cover	

Source: Geomin Resources 2016

APPENDIX D

Technical Memorandum 4

Technical Memorandum 4

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 21, 2017

Subject: Black Butte Copper Project - Tunnel and Shaft Plugs for Controlling Groundwater Flow at Closure

BACKGROUND

The Mine Operating Permit (MOP) for the Black Butte Copper Project (the Project) indicates that during operations, production workings would be continuously backfilled with low-permeability cemented tailings, but access tunnels and ventilation shafts would not be backfilled. During closure, cement plugs would be placed at strategic locations in the decline and access ramps, but these openings would otherwise not be backfilled. A subsurface plug would be placed in each of the four ventilation shafts, and portions of the shafts would be backfilled with non-cemented reclamation fill. The non-cemented fill would have relatively high hydraulic conductivity and not provide a water seal. Except where plugs are placed, this memorandum treats the decline, access ramps, and all ventilation shafts as hydraulically "open."

Baseline data indicate the general presence of upward hydraulic gradients, which would provide the potential for upward groundwater flow after the hydrologic system recovers from the hydraulic stresses imposed by the dewatering operation. Upward flow, if not controlled, could cause mine-impacted groundwater in deeper geologic units to migrate upward and affect the water quality in shallower units, most notably the Lower Newland A Formation (Ynl-A) unit and alluvial units that discharge groundwater into streams. In the natural hydrogeologic system, upward migration is very slow because the geologic units generally have low vertical hydraulic conductivity. However, the presence of (hydraulically) open tunnels and shafts could provide conduits that convey upward flow in a way that by-passes the containment afforded by the natural undisturbed system. Thus, the sealing provided by plugs in otherwise open tunnels and shafts is an important closure issue for the Environmental Impact Statement (EIS).

CURRENT MOP

As discussed in the MOP, the Proponent proposes to install 14 cement plugs at strategic locations in the main decline, deeper access ramps, and four ventilation shafts to restrict upward groundwater flow after closure and prevent human access. The locations of the plugs are shown on MOP Figures 7.4 and 7.5. The purpose of the plugs is to provide the following hydraulic separations:

- Between the Volcano Valley Fault (VVF) and overlying geologic units
- Between the lower and upper mine stopes of the Lower Sulfide Zone (LSZ)

- Between the Lower Copper Zone (LCS) and Lower Newland B Formation (Ynl-B)
- Between the Upper Sulfide Zone (USZ)/Upper Copper Zone (UCZ) and the Ynl-A

A plug would be installed at the water table in the main decline. Five additional plugs would be installed where the decline and all four ventilation shafts intersect ground surface to prevent physical access and invasion of surface water.

CONSTRUCTION ISSUES

The plugs would be installed at the end of mining with the dewatering system still operating to maintain dry excavations. After plug installation, the dewatering system would be turned off (or operated at systematically decreasing flow rates) to allow the mine to flood with groundwater. The engineering design will assess and recommend the construction of plugs that have low hydraulic conductivity to provide adequate sealing and sufficient strength to remain stable when subjected to differential water pressures on opposite sides of the plugs. Construction options include cement-only plugs or cement layered with foam. It is reasonable to assume that the plug material would have an effective hydraulic conductivity less than or equal to 10^{-7} centimeters per second (cm/sec) (0.00028 feet per day [ft/day]).

Two important construction issues are (1) development of cracks in the plug material after placement and (2) incomplete sealing at the cement/rock interface. Historically, both problems have occurred in tunnel/shaft seals but are generally attributed to improper cement mixes or inadequate methods of cement placement. With good quality engineering and modern construction practices, it is expected that these problems could be prevented or minimized.

A less tangible issue is the development of a disturbed zone adjacent to the tunnel or shaft wall due to blasting when the rock is first excavated. The blasting process could create fractures that extend outward from the rock face, and stress release can cause these (and natural) fractures to open. The result could be a zone adjacent to the wall with hydraulic conductivity that is greater than the undisturbed rock further away from the wall. It is considered that the thickness of the disturbed zone could range from 4 to 12 feet; for analyses in this memorandum, a thickness of 8 feet is assumed. The poor sealing performance of some tunnel plugs has been attributed to by-pass in the disturbed zone adjacent to the plug. The MOP states that if a detrimental disturbed zone is suspected, a fracture-grouting program will be initiated to seal fractures prior to plug placement. To do this, boreholes would be drilled outward from the rock face and grout would be injected into fractures under pressure. Experience has shown this technique to have mixed success in reducing groundwater flows below dams or into underground tunnels.

EIS ENVIRONMENTAL ISSUES

An important EIS environmental issue revolves around the function of plugs to reduce upward flow and chemical migration of potentially impacted water from deeper to shallower geologic units. Compared to deeper bedrock units, the Ynl-A has higher hydraulic conductivity and could be used for the development of low-capacity water wells. Groundwater in the Ynl-A unit also tends to discharge into streams, either directly or via alluvium adjacent to the streams. There is concern that open tunnels and shafts extending downward for many hundreds of feet could provide conduits that convey chemically affected water upward at flow rates that are higher than the natural system and with reduced travel times. At a scoping level, this technical memorandum attempts to address the utility of plugs in reducing enhanced upward flow that could otherwise occur in open tunnels and ventilation shafts.

TECHNICAL APPROACH

This memorandum provides a scoping-level evaluation of plug performance using (1) historical documentation, (2) details of the plugging program presented in the MOP, and (3) analytical calculations. It is not meant to be a definitive evaluation of the plug issue; this memorandum is meant to provide evidence on the expected success of plug installation at the Project mine and the ability of plugs to reduce the upward flow and migration of potentially affected mine waters.

USE OF TUNNEL AND SHAFT PLUGS IN MINING

Many mining operations, particularly those in mountainous terrain, rely on tunnel plugs to permanently seal mine adits and to flood (at least in part) the mine workings upon closure. It is generally accepted that the design criteria for permanent mine closure plugs should be stricter than those used during mine operations, particularly if the plug is used to impound acid rock drainage. In most cases, it is the allowable seepage/gradient rather than the shear strength of the rock or concrete that controls the length of the plug (Lang 1999).

The Natural Resources Conservation Service Conservation Practice Standard for Mine Shaft and Adit Closing (Code 457) enumerates the closing of underground mine excavations by filling, plugging, capping, and installing barriers with the following objectives:

- Reduce hazards to humans and/or animals.
- Maintain or improve access and/or habitat for wildlife.
- Protect cultural resources.
- Reduce subsidence problems.
- Reduce the emission of hazardous gases.
- Reduce or prevent contamination of surface water and groundwater.

Kirjapaino Oy (2008) writes that, in addition to reducing subsidence risk, the use of adit plugs can prevent the physical migration of the mine backfill if it becomes saturated with water. Installation of plugs and rock fill is not generally recommended in access tunnels and shafts in case the mine is to reopen at some future date.

Among the plug purposes enumerated on Code 457, two appear to be applicable to the proposed Project upon its future closure: (1) reduce hazards to humans and/or animals; and (2) reduce or prevent contamination of surface water and groundwater.

PLUGGING PROGRAM PRESENTED IN THE MOP

MOP Figures 7.4 and 7.5 show the proposed locations of plugs. ERM's review of the MOP identified the following plug issues that merit additional consideration in the EIS:

- As shown on Figure 7.5, the lower portion of the lower intake ventilation shaft (IVL) is continuously open and connects to the lower decline. The lack of a plug in the lower IVL may negate the hydraulic function of the decline plugs labeled "Upper VVF" and "Below USZ" on Figures 7.4 and 7.5.
- As shown on Figure 7.5, the lower portion of the lower exhaust ventilation shaft (EVL) has no plugs, but connects the middle decline to a lower access ramp. The lack of a plug in this portion of the EVL may negate the hydraulic function of the plug labeled "Upper VVF" on Figure 7.5.
- It is not entirely clear in the MOP which portions of the ventilation shafts would be backfilled.
- The MOP indicates that a plug would be installed at the groundwater table in the decline, but the hydraulic utility of a plug at this location is unclear.

HYDRAULIC ANALYSIS OF PLUG PERFORMANCE

Figure A-1 in Appendix A of this memorandum shows conceptual flow paths for leakage that could occur through and past a tunnel plug. While the plug itself is generally of low permeability and entails minimal flow, significant leakage could occur in the disturbed zone adjacent to the tunnel wall that likely would have higher hydraulic conductivity than the undisturbed rock mass. In this section, scoping-level calculations are performed to evaluate leakage through the plug and in the disturbed zone. Flow in the undisturbed rock mass is not considered because it is expected to be relatively small. However, if the rock mass has appreciable hydraulic conductivity, this flow component might be significant and could be evaluated using numerical methods.

Flow By-Passing a Tunnel or Shaft Plug

The hydraulic performance of a tunnel plug at the Project site was evaluated based on the conceptualization shown on Figure A-2. The plug being considered is for the EVL raise and would be used to hydraulically separate the USZ/UCZ unit from the overlying Ynl-A unit. This location is of interest because the Ynl-A has relatively high hydraulic conductivity and there are nearby piezometers that provide reliable data on the vertical hydraulic gradient (MW-9, PW-9, and PW-10). The hydraulics of a shaft at this location without a plug was independently analyzed in the MOP (Section 4.1.7.2) and summarized on MOP Figure 4.15. At the EVL location, the static hydraulic head in the USZ/UCZ unit is higher than the head in the Ynl-A unit, providing the potential for upward flow, which would be enhanced by the presence of an open shaft. The intended purpose of the plug would be to reduce the upward flow between the two units.

The conceptualization on Figure A-2 considers radial horizontal flow converging into the shaft from the underlying USZ/UCZ unit, flow up the shaft with or without a plug, and radial flow away from the shaft into overlying Ynl-A unit. The system flow rate is affected by flow through a disturbed zone adjacent to the shaft wall that has higher hydraulic conductivity than the undisturbed rock mass. For this evaluation, the disturbed zone is assumed to be 8 feet thick and have a possible hydraulic conductivity (K_d) ranging from 0.1 ft/day (slightly less than undisturbed USZ/UCZ rock) to 100 ft/day for highly disturbed rock.

The following steady-state equation (Theim 1906; Kruseman and de Ridder 1990) is used to compute horizontal radial flow into the shaft from the USZ/UCZ unit (Q_2):

$$Q_2 = \frac{2\,\pi\, K_{h2}\, b_2\, (H_2 - H_{s2})}{F}$$

where:

- K_{h2} = horizontal hydraulic conductivity of geologic materials in USZ/UCZ (0.16 ft/day)
- b_2 = effective thickness of more permeable geologic materials within USZ/UCZ (46 feet)
- H_2 = static hydraulic head in the USZ/UCZ unit (5,703.4 feet mean sea level [msl])
- H_{s2} = Hydraulic head in the shaft below the plug (computed)
- F = steady-state shape factor (5.7)

Steady-state flow from the shaft into the Ynl-A (Q_1) is computed similarly:

$$Q_1 = \frac{2\,\pi\, K_{h1}\, b_1\, (H_{s1} - H_1)}{F}$$

where:

- K_{h1} = horizontal hydraulic conductivity of geologic materials in Ynl-A (1.3 ft/day)
- b_1 = effective thickness of more permeable geologic materials within Ynl-A (46 feet)
- H_1 = static hydraulic head in the Ynl-A unit (5,696.1 feet msl)
- H_{s1} = hydraulic head in shaft above the plug (computed)

The steady-state shape factor (F) for horizontal radial flow is typically given by:

$$F = ln\left(\frac{r_w}{r_o}\right)$$

where:

- r_w = well radius (in this case the shaft radius)
- r_o = radius of influence; distance to where the hydraulic head is near static

The typical value used for practical application is F = 5.7, which implies that the ratio (r_w/r_o) is equal to 300.

The combined vertical flow through the plug and disturbed zone (Q_3) is computed using the Darcy equation:

$$Q_3 = \left(K_p\, A_p + K_d\, A_d\right)\left(\frac{H_{s2} - H_{s1}}{L}\right)$$

where the cross-sectional area of the plug (A_p) is:

$$A_p = \frac{\pi}{4} D^2$$

the cross-sectional area of the disturbed zone (A_d) is:

$$A_d = \frac{\pi}{4} [(D + 2\,a)^2 - D^2]$$

and:

D = shaft diameter (16 feet)

a = thickness of disturbed zone (8 feet)

L = plug length (20 feet)

K_p = hydraulic conductivity of plug material (0.0003 ft/day = 10^{-7} cm/sec))

K_d = hydraulic conductivity of disturbed zone (range of 0.1 ft/day to 100 ft/day)

and other parameters are previously defined.

In the direction of flow, continuity requires that:

$$Q_2 = Q_3 = Q_1$$

Starting with the known static head in USZ/UCZ (H_2), algebraic manipulation of the above equations is used to *compute* a static head in Ynl-A. Then by an iterative process, the system flow rate (Q) is modified until this computed head is equal to the known static head in Ynl-A (H_1). The computations are programmed in the Mathcad worksheet provided in Figure A-3. As a sensitivity analysis, the flow rate (Q) was computed for different values of the disturbed zone hydraulic conductivity (K_d) to evaluate how the plug would perform with different amounts of by-pass leakage in the disturbed zone adjacent to the plug.

Calculations show that if the hydraulic conductivity of the plug material (cement and/or foam) is less than 0.003 ft/day (10^{-6} cm/sec), the flow through the plug can be neglected. However, the system flow rate is affected by the disturbed zone hydraulic conductivity (K_d). To evaluate how the plug might perform, a series of calculations were performed using K_d values ranging from 0.1 ft/day (slightly less than the undisturbed USZ/UCZ hydraulic conductivity of 0.16 ft/day) to a very high value of 100 ft/day. The inputs listed in Figure A-3 are for one realization where the disturbed zone hydraulic conductivity is taken to be 1.6 ft/day, or one order-of-magnitude greater than that of undisturbed USZ/UCZ rock. Other realizations use the same inputs except for the disturbed zone hydraulic conductivity (K_d).

Results of the analysis are shown graphically on Figure A-4. As the disturbed zone hydraulic conductivity (K_d) increases, the upward vertical flow by-passing the plug also increases, which makes logical sense. However, it is surprising that for a three order-of-magnitude increase in K_d, the by-pass flow rate only increases by a factor of three (from 0.08 gallon per minute [gpm] to 0.27 gpm). This is because the effect of higher K_d on flow is counteracted by a reduction in the hydraulic gradient through the disturbed zone. Note that for the K_d values greater than 10 ft/day, the by-pass flow rate is similar to the value computed in the MOP for the case of no plug (0.27 gpm). As K_d increases, the hydraulic head in the shaft below the plug (H_{s2}) becomes more similar to the head above the plug (H_{s1}). For K_d greater than 10 ft/day, the heads are nearly equalized and similar to the value of 5,697 feet msl computed in the MOP for the no-plug case. This analysis suggests that shaft plugs can reduce groundwater flow through a shaft or tunnel; however, for the rock properties considered in this example, the flow reduction (0.27 gpm to 0.08 gpm) is not very large.

At face value, one might interpret from Figure A-4 that the system flow rate can be greatly reduced by grouting fractures in the disturbed zone so that K_d is a very low value. However, the effect of this would be to shift the flow lines to outside the disturbed zone away from the shaft, so the reduction in flow rate may not be as great as envisioned. To properly analyze this type of situation would likely require an axisymmetric numerical flow model, which while doable, was outside the scope of this technical memorandum.

Assuming an effective porosity of 0.10, Figure A-5 shows the migration velocity and sharp-front travel time for unattenuated chemical migration through the disturbed zone. For K_d increasing from 0.1 ft/day to 100 ft/day, the sharp-front travel time decreases from about 77 days to 23 days, which is not a large change.

Natural Vertical Flow

Figure A-6 considers natural vertical groundwater flow in the same geologic units considered for the shaft analysis. Based on calibration of the site groundwater model, the vertical hydraulic conductivity of USZ/UCS unit is taken to be 0.011 ft/day and the vertical hydraulic conductivity of Ynl-A is 0.26 ft/day. The static hydraulic head in USZ/UCZ at PW-9 is 5,703.4 feet msl and the head in Ynl-A at MW-9 is 5,696.1 feet msl. Based on well completion data, the vertical distance between midpoints of the completion intervals for these wells is 110 feet. Because the vertical hydraulic conductivity of the USZ/UCZ unit is lower than that of the overlying Ynl-A, the vertical hydraulic gradient in the USZ/UCZ unit should be greater as shown by the conceptual head distribution graph on Figure A-6. For a given vertical flow rate, the Mathcad worksheet in Figure A-7 computes the map area associated with natural vertical flow for that flow rate. Figure A-7 considers a vertical flow rate of 0.27 gpm, which is the estimated flow rate for the shaft without a plug. The equivalent area of natural vertical flow for this flow rate is computed to be 1.24 acres. Thus, the vertical leakage for a shaft without a plug is equivalent to the natural vertical flow that takes place over a footprint area of 1.24 acres. For the case of a plug with a lower permeability disturbed zone, the estimated shaft leakage is estimated to be about 0.1 gpm, and this is equivalent to a natural flow area of about 0.5 acre. The implication here is that the total upward flow through four vent raises and one decline, with or without plugs, would be relatively small compared to the upward natural flow that occurs over the general area of the mine.

Vertical seepage velocity and travel time in the natural system is also assessed in the Mathcad worksheet. For an effective porosity of 0.10, the vertical seepage velocity is 3.5 feet per year (ft/yr). For the vertical distance of 110 feet between the mid-points of PW-9 and MW-9, the computed sharp-front travel time is on the order of 30 years. Calculations confirm that this travel time is independent of the flow rate considered in Figure A-7.

Discussion

This analysis provides evidence supporting the following statements:

- After closure and hydraulic recovery, the presence of four shafts and one decline, with or without plugs, would not substantially change the natural upward flow that would occur between lower geologic units and the Ynl-A unit. With or without plugs, the upward flow rate through the openings would be small compared to natural upward flow that would occur in areas where there are no mine openings.
- The placement of shaft and tunnel plugs just below the USZ/UCZ – Ynl-A contact would reduce flow in the openings, but the relative decrease would not be very large.
- The greatest effect of shafts and tunnels is reducing the chemical migration times from deeper units into the Ynl-A unit. In areas without openings, the travel time for upward flow in geologic materials would likely be many decades to perhaps centuries. However, where shafts and tunnels would be installed, the upward travel time, with or without plugs, could be less than several years.
- If an environmental priority is to increase the time it takes for chemicals in deeper units to reach the Ynl-A unit, the only practical engineering approach would be to completely backfill the shafts and declines with a granular porous material so that upward (Darcian) flow could occur in a medium with reasonably high effective porosity (which reduces migration velocity). If the backfill were to have low hydraulic conductivity (such as cemented tailings), this approach could eliminate the need for all subsurface plugs.

CONCLUSIONS AND RECOMMENDATIONS

The main conclusion of this technical evaluation is that the upward migration of potentially affected groundwater into shallower geologic units via shafts and tunnels would be relatively rapid regardless of whether or not plugs are installed. Mixing calculations might show that the flow rates are small enough to not significantly impact the Ynl-A water quality, but the time frame for chemicals to migrate up the tunnels and shafts is relatively rapid. Calculations show that placement of plugs would not greatly increase the travel times compared to shafts and tunnels that do not have plugs. If minimizing upward vertical chemical migration from deeper to shallower units is an EIS priority, the only engineering solution may be to completely backfill the decline, access ramps, and ventilation shafts with non-cemented or cemented granular material. It is recommended that this be established as an alternative in the EIS. The alternative might entail stockpiling an adequate volume of tailings or other granular material at the end of mining, which could be used to backfill all tunnels and shafts prior to turn-off of the dewatering system. If tailings are used for backfill, one consequence of this approach would be a smaller ultimate volume of tailings to be placed in the cemented tailings facility (CTF). Engineering options can consider the use of non-cemented or cemented backfill material.

For the closure approach currently described in the MOP, other EIS alternatives may consider the following:

- One additional plug in the lower portion of the IVL to hydraulically separate the VVF from shallower geologic units.
- One additional plug in the lower portion of the EVL to hydraulically separate the VVF from shallower geologic units.
- Elimination of the water-table plug in the decline (labeled “At GWT” on MOP Figures 7.4 and 7.5).

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Lang, B. 1999. “Permanent Sealing of Tunnels to Retain Tailings or Acid Rock Drainage.” In Proceedings of the Mine, Water & Environment - IMWA Congress, Sevilla, Spain.

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Technical Memorandum 4: Appendix A

Figure A-1: Flow Patterns Through and Around a Plug

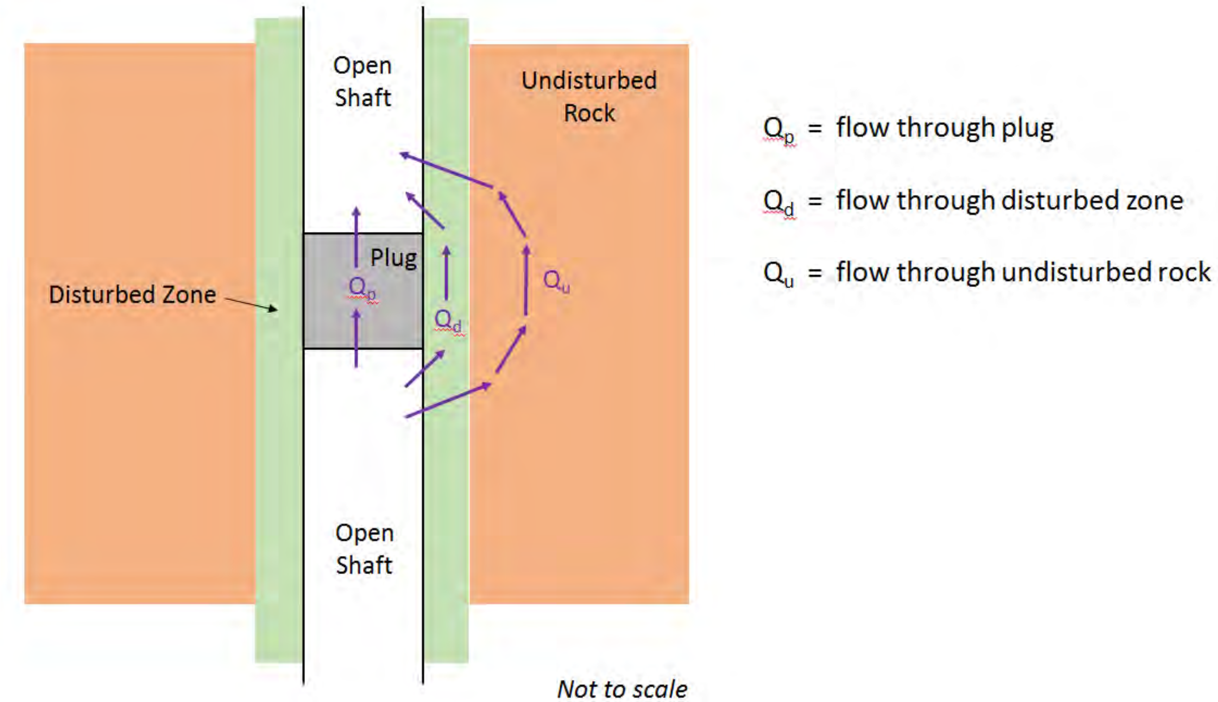


Figure A-2: Flow Analytical Model

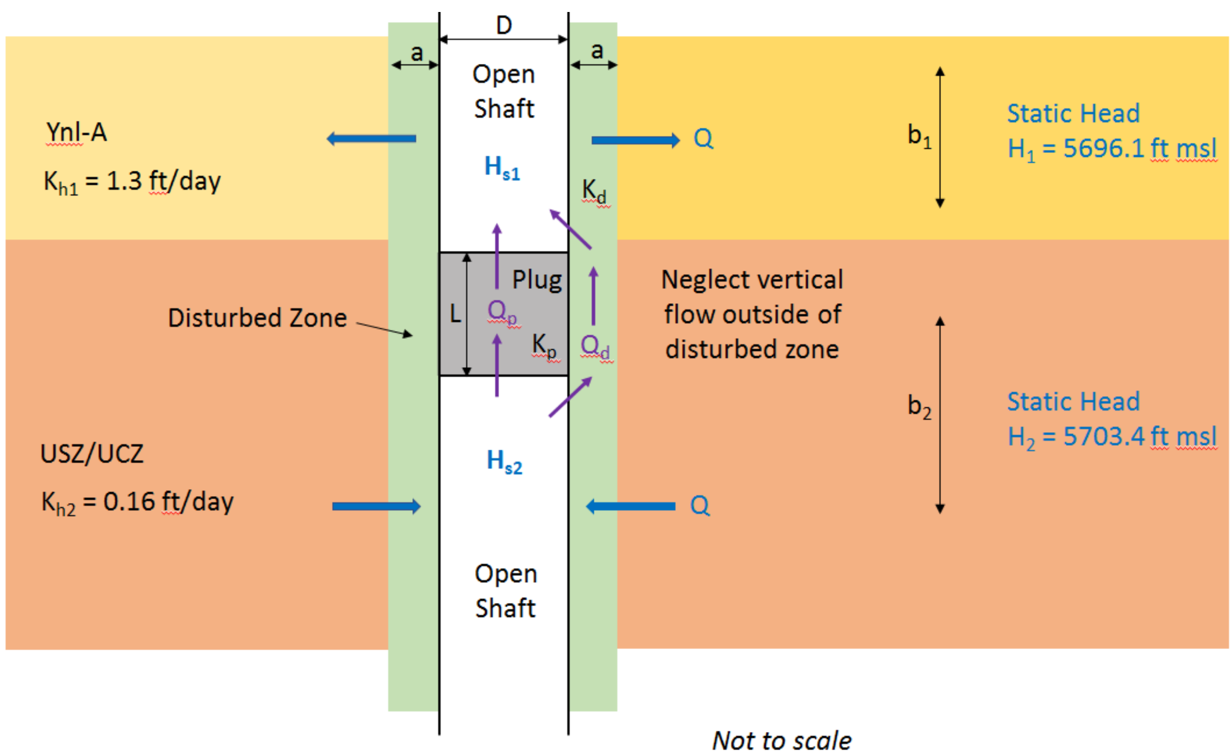


Figure A-3: Flow Through (and By-passing) a Plug

Inputs

$H_1 := 5696.1 \cdot ft$	Static hydraulic head in Ynl-A unit	
$K_{h1} := 1.3 \cdot \frac{ft}{day}$	Horizontal hydraulic conductivity of Ynl-A unit	
$b_1 := 46 \cdot ft$	Permeable thickness of Ynl-A unit	
$H_2 := 5703.4 \cdot ft$	Static hydraulic head in USZ unit	
$K_{h2} := 0.16 \cdot \frac{ft}{day}$	Horizontal hydraulic conductivity of USZ unit	
$b_2 := 46 \cdot ft$	Permeable thickness of USZ unit	
$L := 20 \cdot ft$	Length of plug	
$D := 16 \cdot ft$	Shaft diameter	
$a := 8 \cdot ft$	Thickness of disturbed zone	
$K_d := 1.6 \cdot \frac{ft}{day}$	Hydraulic conductivity of disturbed zone	
$F := 5.7$	Shape factor for radial flow to shaft	
$K_p := 0.000284 \cdot \frac{ft}{day}$	Hydraulic conductivity of plug	$K_p = 1.00 \times 10^{-7} \cdot \frac{cm}{sec}$
$\phi := 0.10$	Effective porosity of disturbed zone	

Calculations

$A_d := \frac{\pi}{4} \cdot \left[(D + 2 \cdot a)^2 - D^2\right]$	Cross-sectonal area of disturbed zone	$A_d = 603.186 \cdot ft^2$
$A_p := \frac{\pi}{4} D^2$	Cross-sectional area of plug	$A_p = 201.062 \cdot ft^2$
$H_{s2}(Q) := H_2 - \frac{Q \cdot F}{2 \cdot \pi \cdot K_{h2} \cdot b_2}$	Hydaulic head in shaft below plug	
$H_{s1}(Q) := H_{s2}(Q) - \frac{Q \cdot L}{K_d \cdot A_d + K_p \cdot A_p}$	Hydraulic head in shaft above plug	
$H(Q) := H_{s1}(Q) - \frac{Q \cdot F}{2 \cdot \pi \cdot K_{h1} \cdot b_1}$	Computed static head in Ynl-A	
$q := 0 \quad Q := root(H(q) - H_1, q)$	Find by-pass flow rate for H(Q) = H_1	$Q = 0.2383 \cdot gpm$
	Computed head in shaft below plug	$H_{s2}(Q) = 5697.75 \cdot f$
	Computed head in shaft above plug	$H_{s1}(Q) = 5696.80 \cdot f$
$Q_p := K_p \cdot A_p \cdot \left(\frac{H_{s2}(Q) - H_{s1}(Q)}{L}\right)$	Computed flow rate through plug	$Q_p = 0.000 \cdot gpm$
$Q_d := K_d \cdot A_d \cdot \left(\frac{H_{s2}(Q) - H_{s1}(Q)}{L}\right)$	Computed flow rate through disturbed zone	$Q_d = 0.238 \cdot gpm$
$v_d := \frac{Q_d}{A_d \cdot \phi}$	Seepage velocity in disturbed zone	$v_d = 0.76 \cdot \frac{ft}{day}$
$t_d := \frac{L}{v_d}$	Sharp-front travel time through disturbed zone	$t_d = 26.302 \cdot day$

Figure A-4: Results of Shaft Plug Analysis

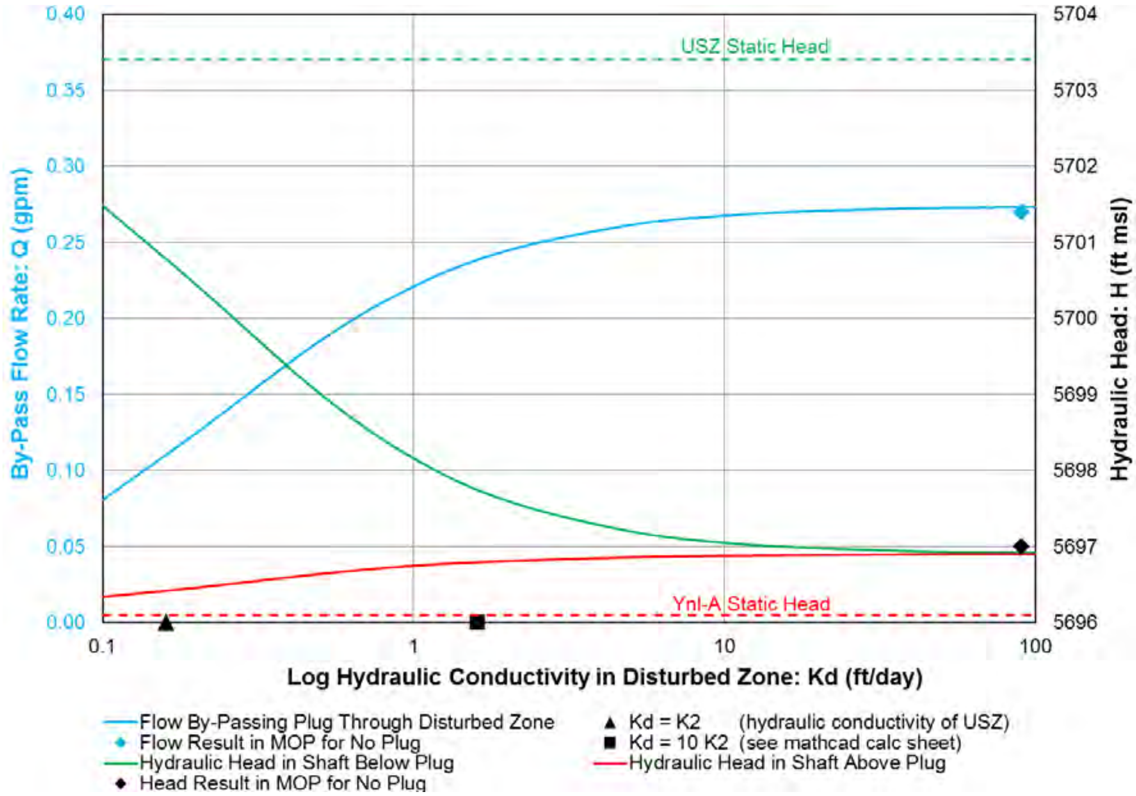


Figure A-5: Chemical Migration Past Plug

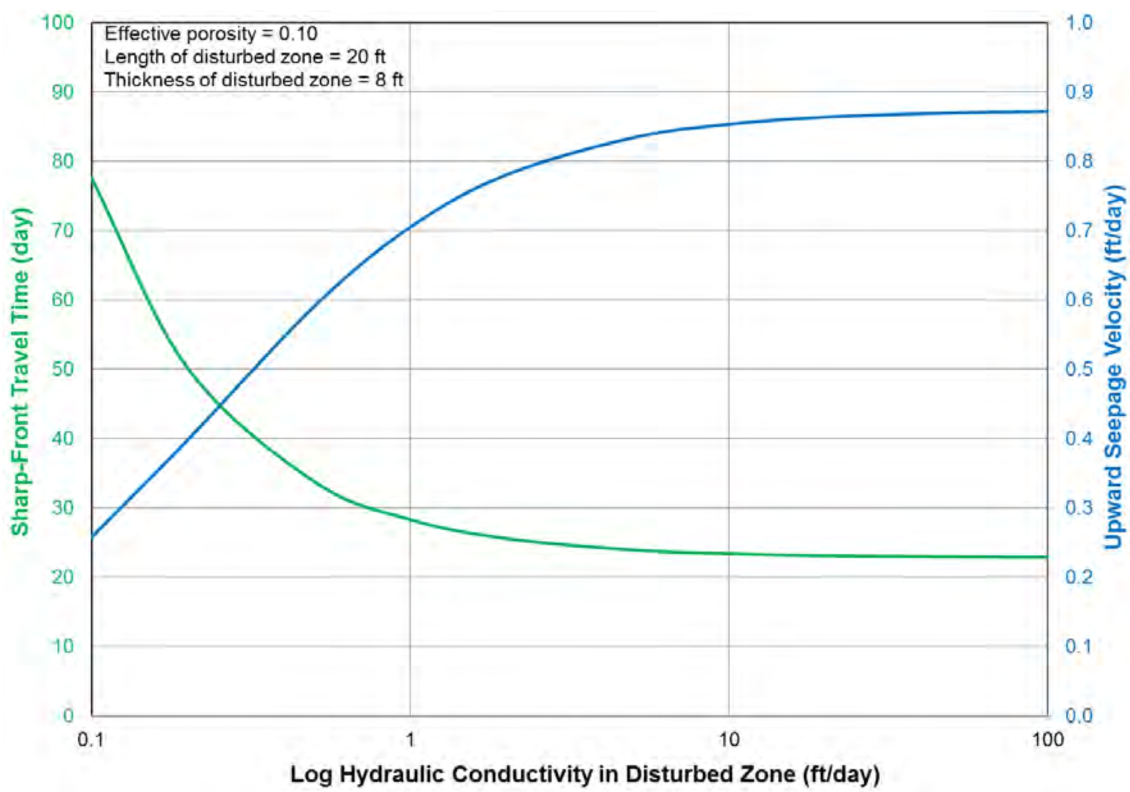
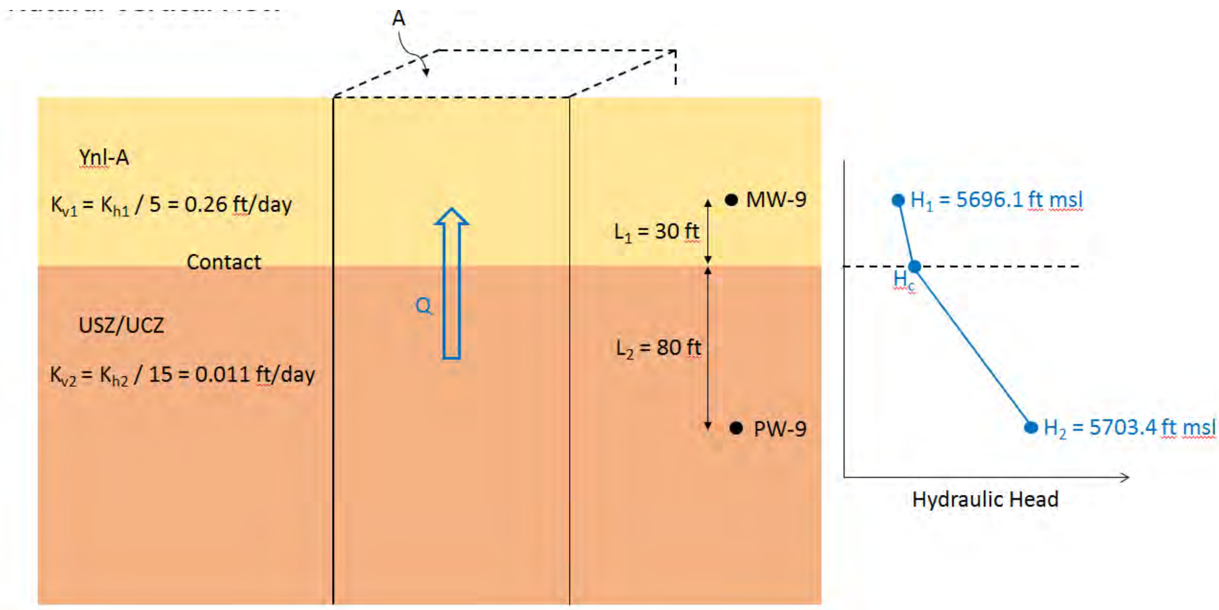


Figure A-6: Natural Vertical Flow



Not to scale

Figure A-7: Natural Vertical Flow (in Absence of Shaft)

Inputs

$H_1 := 5696.1 \cdot ft$	Static head in Ynl-A	
$K_{v1} := \frac{1.3}{5} \cdot \frac{ft}{day}$	Vertical hydraulic conductivity in Ynl-A based on numerical model calibration	$K_{v1} = 0.26 \cdot \frac{ft}{day}$
$L_1 := 30 \cdot ft$	Vertical distance from midpoint of MW-9 completion to the Ynl-A / USZ contact	
$H_2 := 5703.4 \cdot ft$	Static head in USZ (PW-9)	
$K_{v2} := \frac{0.16}{15} \cdot \frac{ft}{day}$	Vertical hydraulic conductivity in USZ based on numerical model calibration	$K_{v2} = 0.011 \cdot \frac{ft}{day}$
$L_2 := 80 \cdot ft$	Vertical distance from Ynl-A / USZ contact to midpoint of MW-9 completion	
$Q := 0.27 \cdot gpm$	Vertical flow rate considered	
$\phi := 0.10$	Effective porosity of undisturbed rock	

Calculations

$H_c(A) := H_2 - \frac{Q \cdot L_2}{K_{v2} \cdot A}$	Hydraulic head at Ynl-A / USZ contact	
$H(A) := H_c(A) - \frac{Q \cdot L_1}{K_{v1} \cdot A}$	Computed static head Ynl-A (MW-9)	
$a := 0.5 \cdot acre \quad A := root(H(a) - H_1, a)$	Find map area for which computed head in Ynl-A equals H_1 when vertical flow rate is Q	$A = 1.24 \cdot acre$
	Actual head head in Ynl-A (MW-9)	$H_1 = 5696.1 \cdot ft$
	Computed head in Ynl-A (MW-9)	$H(A) = 5696.1 \cdot ft$
	Conputed head at Ynl-A / USZ contact	$H_c(A) = 5696.2 \cdot ft$
	Head in USZ (PW-9)	$H_2 = 5703.4 \cdot ft$
$i_1 := \frac{H_1 - H_c(A)}{L_1}$	Vertical hydraulic gradient in Ynl-A (negative for upward flow)	$i_1 = -0.004$
$i_2 := \frac{H_c(A) - H_2}{L_2}$	Vertical hydraulic gradient in USZ (negative for upward flow)	$i_2 = -0.090$
$v := \frac{Q}{A \cdot \phi}$	Vertical seepage velocity	$v = 3.50 \cdot \frac{ft}{yr}$
$t := \frac{L_1 + L_2}{v}$	Sharp-front travel time over 110 vertical feet from PW-9 to MW-9	$t = 31.4 \cdot yr$

APPENDIX E

Technical Memorandum 5

Technical Memorandum 5

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring in-situ treatment through placement of organics in the underground workings at closure to limit oxidation

BACKGROUND

In the drift and fill mining technique, cemented paste tailings would backfill the underground workings in operation and through closure. The cemented paste tailings would contain alkaline materials such as fly ash, lime, and other locally sourced materials that would partially neutralize acids. There are concerns that there is not sufficient alkalinity or neutralizing capacity in the cemented paste tailings to prevent acid mine drainage. At closure, the mine would be flooded and the paste tailings would reside below the groundwater table in an anoxic and, depending on depth, anaerobic environment. The hydraulic conductivity of the cemented paste tailings would limit interaction with groundwater. This Technical Memorandum examines the additional control measure of adding a carbon source to the underground workings to promote the growth of bacteria that would reduce sulfate and precipitate metal sulfides and increase the pH and alkalinity.

CURRENT MOP

To limit groundwater inflow and therefore oxidation and acid mine drainage, the Mine Operation Plan (MOP) (Tintina Montana, Inc. 2017) proposes the following: (1) installing hydraulic plugs to separate the lower mine workings from the upper groundwater, (2) shotcreting high sulfide zones, (3) high pressure rinsing of the mine walls with unbuffered Reverse Osmosis (RO) treated water to remove soluble sulfates and other oxidation products, and (4) collecting and treating this rinsate to non-degradation standards. At closure, buffered RO permeate would be injected into the underground workings followed by low-oxygen groundwater. The MOP also describes a “wait and see” approach to tailor the additional controls based on the resulting water quality versus the predicted (modeled) water quality at mine closure. Control measures would be tested during the operations phase, and the most successful measures would be adopted at closure.

The cemented paste tailings backfill (79 percent total solids by weight of the mixture) would be produced onsite by mixing fine-grained tailing from the milling process and 2-4 percent cement and proposed binders, such as locally available cement, slag, and fly ash. Over time, Humidity Cell Tests (HCT) results described in the MOP predict that the cemented paste tailings could potentially oxidize if exposed to air and water and release acid. In the drift and fill mining process, Tintina maintains that the backfilled material would not be exposed to air for an extended period of time; in addition, at closure the backfill would be immersed with groundwater. Since diffusion of oxygen through saturated material is considerably slower than direct contact with air, oxidation would be minimized at closure. The deeper the groundwater, the more likely anaerobic conditions would prevail. Interaction with groundwater should also be minimized due to the low hydraulic conductivity of the backfill placed during the operational phase.

EIS ENVIRONMENTAL ISSUES

The potential environmental impacts would result from the oxidation of the rock surfaces in the underground workings, producing acidic conditions and leaching metals and metalloids into groundwater. Anoxic conditions can promote the release of arsenic into groundwater by increasing its solubility.

TECHNICAL APPROACH

PASSIVE BIOLOGICAL TREATMENT

Sulfate can be reduced to sulfides in anoxic conditions with the addition of organic substrates due to the presence of naturally occurring anaerobic bacteria *Desulfovibrio* and *Desulfotomaculum.* During respiratory metabolism, sulfates, sulfites, and other reducible sulfur species act as electron acceptors. These anaerobic bacteria utilize an organic substrate of short chain lactic and pyruvic acid that can be generated from the fermentation by other anaerobic bacteria of other organic substrates. Anaerobic conditions must be created and complex organic materials (e.g., molasses, sewage sludge, manure, and substrates such as straw, newspaper, manure and sawdust) must be introduced. To precipitate specific metals, the pH needs to be in the proper range, with copper and iron precipitating at low pH levels (Bowell 2004).

Passive Treatment systems are typically used for biological treatment of mine wastes and are defined as systems that use naturally available energy sources such as microbial metabolism. These systems typically require some long-term, infrequent maintenance to operate over a designated design life. To cultivate sulfate reducing bacteria (SRB), certain conditions are required. SRBs require a pH around 6, a substrate, a carbon source, and anoxic conditions. SRBs may use a wide range of substrates as electron donors and carbon sources, which oxidize incompletely (to acetate) or thoroughly to carbon dioxide (CO_2). These substrates are generally organic compounds composed of activated sludge, wood chips, farm manure, sawdust, mushroom compost, and other agricultural wastes (Luptakova 2012).

Domestic animal waste contains sulfate reducers and has been used to seed anaerobic bioreactors. Sulfide precipitation of metals is possible in anaerobic bioreactors. For pH less than 5.5, hydrogen sulfide gas was produced that precipitated metals and formed bicarbonate, raising the alkalinity and pH of the water. This study found that SRBs function optimally at pH values greater than 5.0 with a source of sulfate and a carbon source (Gusek 2016).

A thick cover layer of organic material over piles of tailings and waste rock has been effective in reducing oxidation, as the oxygen is depleted by the microbial degradation of the organic material. Microbial degradation and oxygen consumption has been most effective at a near-neutral pH. In above ground conditions, cover materials need to be replaced when the carbon has been depleted (Butler 2014).

Types of passive biological treatment systems for mine wastes have included the following (Kaupilla 2012):

- Construction Wetlands – Organics with alkaline material promoting sulfate reduction, precipitation of metal sulfide, adsorption of metals to organic material, and neutralization of water.
- Organic filters – Addition of organic material such as peat, manure, or others along with alkaline materials to sorb the metal onto the solid surfaces through either physical or chemical adsorption and water neutralization.
- Reactive ditches – Ditches containing carbonate materials to neutralize water, precipitate iron, and retain precipitates in the cell.
- Reactive dams/walls/curtains – Organic material such as peat and manure combined with alkaline materials to promote the adsorption of metals onto the surface of the solids and neutralize water.

None of these passive treatment systems is applicable for the Black Butte Copper Project (the Project) unless underground organic filters or reactive dams/walls/curtains could be built and maintained underground at closure, which is not a practical long-term solution.

Literature Review has provided a number of examples of mostly experimental and pilot-scale passive biological treatment systems, as follows:

- Two anaerobic pilot cells were built at the closed Brewer open pit gold mine in South Carolina and treated pit and cyanide heap leach pad (Pad 5) flows of 1.0 and 0.75 gallons per minute (gpm) for 18 months. Cow manure was used as an inoculum of SRB onto a substrate of composted turkey manure, sawdust, and phosphate rock reject (limestone). The cell experienced fluctuating influent concentrations and a flourishing plant growth that removed iron through oxidation, but not copper. Once the plant growth was removed for the second time, metals removal and sulfate reductions were higher than predicted despite an increased metal loading. This was possibly due to the presence of a more available carbon source provided by the dead plant material (Gusek 2016).
- A pilot scale downflow anaerobic cell was constructed at an abandoned underground copper mine in Wyoming (Ferris Haggarty Mine/Osceola tunnel). Fed with 3 to 6 milligrams per liter (mg/L) of dissolved copper and less than 100 mg/L of sulfate, the 15-foot diameter by 4-foot deep cell was constructed of sawdust, hay, limestone, gypsum, and cow manure as a source of SRB. The cell was allowed to incubate at summer temperatures in 1996 prior to the addition of the mine flow, which appeared to help the SRB acclimate to the subfreezing conditions experienced during the winter months. Effluent copper concentrations from the cell were measured at 0.1 mg/L (Gusek 2016).
- Batch experiments in bioreactors were conducted using synthetic mine water and treatment with limestone, activated sludge, spent mushroom compost (SMC), and mixed substrates

under anoxic conditions. The removal of heavy metals such as iron, manganese, copper, lead, and zinc was evaluated. SMC had the best sulfate and heavy metal removal, with an overall efficiency of 89.98 percent with good alkalinity generation. Activated sludge reduced heavy metals by 97.98 percent but was not as efficient for sulfate removal (43.75 percent) (Muhammad et al. 2015).

- A pilot (research) passive treatment system was installed in 1994 at a closed tin mine in Cornwall, United Kingdom (Wheal Jane). Aerobic, anaerobic, and rock filter systems were tested in the pilot study. The anaerobic system was intended to promote sulfate reduction and increase alkalinity, pH, and precipitation of copper, zinc, cadmium, and iron sulfides. Two pretreatments to the anaerobic cells were tested, and lime was dosed to increase the pH and passage through an anoxic limestone drain. The anaerobic cells were essentially compost bioreactors that had been filled with manure as a source of organic carbon and straw and sawdust as substrate. The bioreactors were monitored regularly; after 2 years, they did not perform as expected, mainly due to the introduction of ferric solids from the aerobic cells. The anaerobic process did not bring the pH up to over 5.5, increase the alkalinity, or remove metals through sulfide precipitation (CL:AIRE 2004).
- A biotreatment system was constructed at an operating underground lead mine (Asarco Incorporated West Fork Unit, Missouri). Mine drainage contained 0.4 mg/L of lead and 0.18 mg/L of zinc with a flow rate of 1,200 gpm. The biotreatment system had multiple parts including a settling pond, two anaerobic cells, a rock filter, and an aeration pond. This system from the beginning of operation has been able to meet permitted discharge requirements with lead reduced to 0.027 to 0.050 mg/L from 0.4 mg/L and reduction in zinc, cadmium, and copper concentrations. From the conclusions to this study, SRB were responsible for the bulk of the lead removal (Gusek 2016).
- Acidophilic microbes responsible for sulfide dissolution and influence on leaching rates at the Iron Mountain mine in California included Eukarya, Bacteria, and Archea (prokaryotes). Subsurface, chemosynthetic prokaryotes utilized reduced iron and sulfur from pyrite for energy and fixed carbon monoxide for cell carbon. Heterotrophic microbes utilized organic carbon for energy in the environment (Edwards et al. 2000).
- The addition of natural phosphate rock has been shown to promote the biofilm growth of heterotrophic microbes that consume oxygen and promote reducing conditions. These heterotrophs are typically out-competed by the acidophilic microbes that are responsible for the acid generation. Fine-ground natural phosphate rock was slowly dissolved in water and applied to tailings. Natural phosphate rock contains calcium-carbonate and phosphate and has been used to neutralize acidic soils. It also contains inorganic and organic carbon and other microbial growth nutrients. In studies with a number of different types of mine tailings and rocks, the research has shown that a one-time application of natural phosphate rock to both tailings and waste rock will promote the development of heterotrophic microbial biofilms (Kalin 2015).

TOTAL ORGANIC CARBON CONTENT OF WASTE ROCK

In the MOP, Total Organic Carbon (TOC) was measured in a range of 0.13 to 0.39 percent for waste rock samples collected at the Project site. Under the right conditions, the rock TOC content could provide an electron donor to promote microbial activity – the type dependent on the pH and the oxygen content. For SRB, the conditions need to be anaerobic, growth substrate, near neutral pH, and a sufficient carbon and nutrient source. Additionally, the TOC would have to be at the exposed rock surfaces and available to a microbial population. It is unlikely that the native TOC would sustain the desired outcome of sulfate reduction, metal sulfide precipitation, and pH and alkalinity increase.

NEUTRALIZING CAPABILITIES OF THE WASTE ROCK

The neutralization potential of the rock can be indicated by the carbonate and silicate content, with carbonate being a stronger indicator. Carbonates and clays present effective acid neutralizing capabilities. The actual amount of acid produced would be determined by the overburden geochemistry, tailings management during reclamation, and the hydrology of the site after closure (Skousen 2002).

There is neutralization potential in the Lower Newland A Formation (Ynl-A) with a net neutralization potential of 164.9 (mean) and in the Lower Newland B Formation (Ynl-B) with a net neutralization of 174.7 (mean). However, to be the most effective, the availability of the oxides and carbonates would be improved if the material was finely ground into particles that would react and neutralize acids. There would be some neutralization with the exposed rock surfaces. Further study is needed to explore the costs/benefits of producing finely ground waste rock and filling the mine void. Per the MOP, locally sourced materials would be added primarily for structural support but as a secondary benefit to increase the neutralizing capabilities of the cemented pastes. Effective additives for neutralizing acidic rock include limestone with a neutralization potential of 75 to 100 percent or fluidized bed combustion ash at 20 to 40 percent (with cementing properties). Lime and cement kiln dust contain 50 to 70 percent unreacted limestone, absorb moisture and harden upon wetting, and are commonly used for stabilization and binder materials (Skousen 2002). Use of these materials would be more practical as they are available and abundant waste materials and are already finely ground with reactive surfaces for neutralizing acid mine waste.

MINE INERTING WITH NITROGEN PRIOR TO CLOSURE

Historically, the use of nitrogen gas in the mining industry has been for extinguishing coal mine fires. It has the potential to inert abandoned or worked-out mines that have not been adequately sealed (Parker Hannifan Corporation 2011). Mine sealing with nitrogen generated onsite was investigated in a study at the National Institute for Occupational Safety and Health (NIOSH) Safety Research Coal Mine (SRCM). The objective was to extinguish oxygen in the mine so that the atmosphere would not support combustion (Trevits et al. 2009). While the nitrogen generator was successful at inerting the SRCM, testing in an actual mine was still recommended.

Inerting by injecting nitrogen gas into the underground mine just prior to flooding could displace oxygen and reduce the oxidation potential of the mined surfaces. Some of the uncertainties center on the quantity of nitrogen needed, whether onsite production would be beneficial to the use of delivered cryogenic nitrogen, how well the mine is sealed to prevent the escape of the nitrogen and influx of other gases, and the timing of the inerting with flooding. Cost versus effectiveness compared to other more conventional methods should also be considered.

MOBILIZATION OF METALS IN ANOXIC/ANAEROBIC CONDITIONS

Anoxic conditions are defined when dissolved oxygen levels fall to below 0.5 mg/L (Ohio EPA 2014). Other subcategories of anoxic conditions are defined by what inorganic compound acts as the main electron acceptor (i.e., nitrate reducing, iron/manganese reducing, sulfate reducing). Anaerobic conditions are the complete absence of oxygen. In reducing conditions, metals can be present as sulfide minerals either from the ore deposit or from bacterial reduction of sulfate in oxidized rock and tailings. Metal sulfides remain immobile as long as they remain in a reducing environment. Metal hydroxides have low solubilities in neutral pH ranges. Their solubility increases with decreased pH (John and Leventhal 2004). Arsenic exists in the groundwater near the Black Butte Copper ore deposit. The additional release of arsenic into the groundwater as a result of mining activities is a complex interaction of the solid phase arsenic and other metal (such as iron) content and the dissolution/ desorption processes that may occur. Although arsenite (AsIII) is thermodynamically favored in anoxic water, both forms have been observed (Shankar 2014).

CONCLUSIONS AND RECOMMENDATIONS

The conclusions from this technical memorandum are listed as follows:

- SRB metabolic reactions consume energy sources and reduce sulfates to sulfides that precipitate metal sulfides and increase the pH and alkalinity of the water.
- The conditions proposed in the MOP at closure involve the creation of anoxic and anaerobic conditions (at depth) by flooding the underground workings. SRBs require more than just anoxic/anaerobic conditions. They require:
  - Inoculation of SRBs (if not present) by adding a source such as manure;
  - pH around 6;
  - Carbon source and nutrients; and
  - Growth substrate.
- While SRBs can be cultured under the conditions listed above, the establishment of a viable bioculture, growth substrate, and replenished carbon source needed to promote ongoing sulfate reducing conditions is questionable.

- Passive systems have typically been constructed bioreactors or a thick cover of organics over the top of a tailings pile, which need long-term, infrequent maintenance to operate effectively.
- The TOC of the native rock may be used by naturally occurring SRBs at depths in the right conditions, and may provide some sulfate reduction depending on the availability of the TOC within the rock.
- There is not enough experience with nitrogen inerting in full-scale mines to predict success in this application.
- Addition of a carbon source in the underground workings at closure by itself is unlikely to be effective in creating a bioreactor capable of sulfate reduction.

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APPENDIX F

Technical Memorandum 6

Technical Memorandum 6

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring additional source controls (prevention of water inflow or application of treatment to rock faces) to limit oxidation during operation

BACKGROUND

During operation, Tintina plans to backfill production workings with a paste of tailings, cement, and binders. The backfill would provide structure to prevent subsidence; it would minimize groundwater contact with exposed rock both during operation and through closure and provide some neutralizing capability. The estimated surface area of the underground mine exposed to both air and groundwater inflow water would thereby be reduced at any given time. The Mine Operation Plan (MOP) also describes the grouting of fractures to limit intrusion of groundwater and collection and treatment of groundwater inflow (Tintina Montana, Inc. 2017). Water inflow would supply all of the water for the mine operation, although only 40 percent of the predicted inflow would actually be needed. All groundwater inflow would be collected and treated to non-degradation standards.

If inflow could be reduced, less water would have to be collected and treated. This Technical Memorandum explores the advantages of additional control measures to limit inflow and oxidation during operation.

CURRENT MOP

The groundwater inflow is estimated to be in the 420 to 500 gallons per minute (gpm) range during active mining, with occasional spikes of up to 1,000 gpm. Inflow and exposure to sulfates and metal oxide in the mined areas would need to be reduced as much as practical during operation. To limit inflow and groundwater contamination, planned procedures in the MOP include:

- Grouting – Tintina plans to grout major water bearing fractures or faults as they are encountered using pressure grouting techniques (sealing fractures by injecting a cement-based grout or a solution-based chemical mixture and diverting water around openings). One of the areas where grouting is anticipated to eliminate significant inflow due to fractures is underlying Coon Creek. According to the MOP, grouting the near-surface portion of the decline would substantially reduce mine inflow, with a ten-fold reduction in the first year according to model predictions.
- Use of Pilot Holes – Pilot holes ahead of the advancing mined face would be drilled to locate water-bearing geological structures. When or if large amounts of water are encountered in a

pilot hole, a packer would be installed to seal the hole. Following installation of the packer, directional grouting would be done prior to advancing.

- Collection and Treatment of Inflow – Groundwater inflow would provide the water needed for mine operation; however, only 40 percent of the estimated groundwater inflow would be needed. The remaining 60 percent would be treated to non-degradation standards and discharged to the upland underground infiltration galleries (UIGs) or to the alluvial UIGs if necessary.
- Cemented Tailings Backfill – During operation, a plant would be constructed to produce a paste (79 percent total solids by weight of mixture) comprised of fine-grained tailing from the milling process and 2-4 percent cement with proposed binders such as locally available cement, slag, and fly ash. The cement binder used to make the cemented tailings paste would also contain hydrated lime and should have neutralizing abilities. The low hydraulic conductivity of the backfilled tailings would reduce contact with groundwater.

ENVIRONMENTAL IMPACTS

The environmental impact of inflow would be the contamination of groundwater by exposure to oxidized surfaces and the dissolution of sulfates and heavy metals. Control of groundwater contamination would substantially reduce the amount of treatment needed and promote the ability of the planned treatment system to meet non-degradation standards.

TECHNICAL APPROACH

Methods of controlling groundwater inflow and contamination during operations are summarized in the following table (Kauppila 2011):

Method	Description	Applicability to Tintina BBC Mine
Paste Cover	Mixing fine-grained millings, cementitious materials, and water into pastes and covering tailings and exposed rock provides a barrier to oxidation	Planned use
Blending and backfilling mined areas	Blending waste rock and/or tailings with paste or neutralizing rock and returning to the excavated areas that are either filled with water or sealed from groundwater intrusion	Planned use
Sealed waste handling structures/dams	Sealing/liners/dam structures to prevent water intrusion and pickup of acid forming materials and heavy metals	Planned use

Method	Description	Applicability to Tintina BBC Mine
Depyritizing	Full or partial removal of iron sulfide from the waste to remove the acid-forming material prior to backfilling or placement in waste ponds	Evaluated in another Technical Memorandum
Water Cover	Owing to the significantly lower concentration and diffusion of oxygen in water, oxidation and acid production on tailings, waste rock and exposed rock surfaces can be limited through a water cover	Planned for by Tintina at closure (i.e., saturation of backfill with ambient groundwater), not practical during operation
Separation of acid and alkaline wastes	Acid forming tailings are separated to reduce the amount of material needing treatments to reduce oxidation	Applicable to tailings treatment, does not apply to underground mine surfaces
Encasing acid wastes within alkaline wastes	Carbonate/neutralizing tailing or waste rock coats or cover acid-forming material for either aboveground disposal or backfilling	Applicable to tailings treatment, does not apply to underground mine surfaces
Reactive Surface Coating	Coating tailings and/or waste rock with reactive materials such as organics to neutralize acid and bind or precipitate heavy metals	Use of organics to promote biofilms evaluated in another Technical Memorandum
Chemical Addition	Adding lime or other chemicals to neutralize acids	Lime and other alkaline materials would be a component of the cemented tailings backfill

Traditional and non-traditional surface coatings for sealing mined surfaces were evaluated in literature studies and are summarized in the following table (Haug and Pauls 2001):

Method	Description	Applicability to Tintina BBC Mine
Asphalt	Production of asphalt in a batch plant and application to mined surfaces	Can be used to limit oxidation, is subject to degradation over time, not practical for underground mine applications
Cementitious cover	Polypropylene fiber reinforced shotcrete	Planned use
Cement-stabilized coal fly ash grout	Fly ash mixtures and geopolymers	Planned use

Method	Description	Applicability to Tintina BBC Mine
Synthetic liners and covers	Geomembranes, spray-on membranes barriers, and geosynthetic clay liners	Spray on membrane barriers can be effective in limiting oxidation
Bentonite modified soil barriers	Soil-bentonite mixtures, polymer modified soil, and polymer surfactants	Can be used to limit oxidation, more appropriate for tailings piles and ponds
Mine Waste Tailings	Tailings and waste rock covers	Planned use
Wax barriers	Wax application to mined surfaces	Can be used to limit oxidation, are subject to degradation over time, not practical for underground mine applications

Some of these materials are only appropriate for covers or containment and not appropriate for surface treatments designed to mitigate acid formation. Prevention of acid formation requires the coating to be impermeable to oxygen transfer and resistant to acid degradation. The results of the evaluations showed that asphalt, wax, and spray-on membrane could be somewhat successful to limit oxygen transfer and liners such as geosynthetic clay liners and soil; modified soil barriers are only effective if they are maintained in a saturated state. Asphalts and waxes are subject to degradation if exposed for extended periods of time. None of these would be appropriate for sealing underground workings during operation to limit oxidation. The modification of fine grained and waste rock with bentonite, fly ash, or other materials could provide a surface cover that would limit oxygen transfer, be resistant to degradation, and provide structural support (Haug and Pauls 2001). This is similar to the Tintina MOP planned use of cemented tailings.

Butler (2014) describes using waste rock/tailings and grouting to seal cracks and fractures, and grout curtains to intercept groundwater flow paths. Additionally, flooding the mine workings before oxidation occurs can help to establish an anaerobic environment (Butler 2014). A large zinc-copper mine near Crandon, Wisconsin proposes to use grouting of underground mine working and active treatment of contaminated groundwater (Leopold et al. 2001). All of these methods except the grout curtains are in the Tintina MOP. Shotcrete could be produced that exhibits characteristics of high strength, low permeability, and good homogeneity. If shotcrete were to be applied over the top of rock surfaces, it would need to occur shortly after exposure. If the rock surfaces have already oxidized, the sulfate could attack the shotcrete and deteriorate the lining. Sulfate resistant cement could be used where sulfate attack is likely (Ma 2011).

CONCLUSIONS AND RECOMMENDATIONS

A technical review of the available sources compared to the MOP finds that most of the commonly used methods to control inflow are planned for use by Tintina. Other methods may have potential application but should only be considered if the control measures tested during the operations phase are unsuccessful.

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APPENDIX G

Technical Memorandum 7

Technical Memorandum 7

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring alternative water treatment technologies rather than the proposed reverse osmosis treatment

BACKGROUND

Groundwater collected during the dewatering of the underground workings starting in year 2 of construction through closure would be collected and treated in a water treatment system that includes a dual pass Reverse Osmosis (RO) system. Approximately 60 percent of the groundwater would be treated to non-degradation standards and discharged under the conditions of a Montana Pollutant Discharge Elimination System (MPDES) permit through upland underground infiltration galleries (UIGs) to shallow bedrock, or into an infiltration gallery located in the Sheep Creek alluvial aquifer system. There are concerns with the ability of the water treatment system to effectively treat the water in all phases of mine operation to non-degradation standards, particularly for nitrates, and the disposition of the large volume of waste brine generated from the RO system.

CURRENT MOP

There are three phases of water management: Construction, Operation, and Closure. During construction, no water would be treated in the first year, and an estimated 250 gallons per minute (gpm) is anticipated in the second year. RO with pretreatment would be used to treat dewatering flow. Pretreatment prior to RO for all three phases includes ferric chloride precipitation/ coagulation of metals and solids and settling, followed by multimedia and cartridge filtration. The pretreatment and RO system treats the water to non-degradation standards. Following the RO system, treated water would be discharged primarily to the alluvial UIG (if needed) under the conditions of the MPDES permit. Treatment residuals would be stored in the Contact Water Pond (CWP). RO blowdown (brine) would be further treated in a Vibratory Shear Enhanced Process (VSEP) system to reduce its volume prior to storage in the brine cell or the CWP. The VSEP is a membrane system that uses vibrational shear forces to reduce membrane fouling, resulting in the ability to treat brine streams and recover water while reducing the brine volume (Johnson 2002). Constituents of concern for treatment during the Construction phase include arsenic, lead, strontium, thallium, total suspended solids (TSS), and nitrogen (nitrate, nitrite, etc.) species. Nitrogen species that originate from blasting operations are predicted to be removed in the RO system. An estimated 48.1 million gallons of RO blowdown would be generated during the 2-year Mine Construction Phase and stored in the CWP brine cell or hauled offsite, if necessary.

In the Operations phase, the treatment capacity would be increased to 588 gpm, with only 497 gpm treated with RO. The remaining water would be used in the Mill. During Operations, water would be a mixture of underground, process, and contact water. Constituents of concern would include pH, dissolved metals (antimony, arsenic, copper, lead, nickel, strontium, and thallium), nitrogen species (nitrate, nitrite, and precursors), and TSS.

The VSEP would not be used during the Operations phase as there are multiple onsite disposal options for the brine, and volume reduction is not needed. One brine disposal option is to pump the brine to the Process Water Pond (PWP). A second option is to pump the brine to the mill thickener. Both options would involve the incorporation of the brine into the cemented tailings paste for permanent disposal.

In the Closure phase, the RO system would be used at full capacity (500 gpm) to produce water to rinse the underground workings. RO blowdown would be volume reduced with the VSEP and shipped offsite. Water treatment would have the same effluent goals of not exceeding the Estimated Maximum Allowable Effluent Concentrations (EMAEC) throughout the three phases; however, the influent quality would vary.

Tintina maintains that the anticipated nitrate concentration from the water treatment facility would be below the groundwater non-degradation level. For the surface water alluvium (Little Sheep Creek), the non-degradation criteria for Nitrate + Nitrite (as N) is 11.29 milligrams per liter (mg/L), and Total Nitrogen at 0.61 mg/L. The predicted quality from the water treatment facility is estimated for Nitrate + Nitrite (as N) at 0.22 mg/L and Total Nitrogen at 0.32 mg/L. If these systems function as predicted, there should be no issues with meeting the non-degradation standards.

EIS ENVIRONMENTAL ISSUES

The potential environmental impacts would be with the water treatment system not consistently meeting non-degradation standards, particularly for nitrates and the disposition of the brine from water treatment from Construction through the Closure phases.

TECHNICAL APPROACH

RO membranes have a pore size of less than 0.002 micron and are susceptible to fouling by particulates, gas bubbles, and other fouling contaminants, requiring pretreatment of the influent beforehand. Constituents found in mine dewatering than could cause problems with RO membrane are iron salts, silica, calcium sulfate, and calcium carbonate (Chambers 2014). These constituents can reach saturation and cause scaling due to precipitate solids on the membrane. This causes reduced permeate flux and downtime of the treatment system to de-scale the membranes. Removal of cations through softening is a common RO pretreatment to increase the permeate recovery and reduce maintenance. Calcium, magnesium, and iron can be removed through hydroxide or sulfide precipitation, softening, or ion exchange. Precipitation produces a metal sludge that has to be disposed. Softeners and ion exchange processes require regeneration, which also produces a brine or concentrated waste that needs disposal. RO systems produce a significant amount of concentrated blowdown or brine for disposal. The permeate recovery and success of mine water treatment would depend on how well the pretreatment removes the scaling (calcium, iron) constituents in the water (USEPA 2003).

RO is a technically feasible treatment to remove nitrates. Rejection rates for sodium chloride and sodium nitrate can be as high as 98 percent and 93 percent, respectively (Jensen et al. 2012). RO membranes theoretically can reject as much as 99.5 percent of all dissolved ions including sodium, nitrate, and chloride (Dahm 2014).

While the most common application for RO is drinking and high-purity water treatment, RO has been considered in mining operations. In a report on water management in mines across the globe, RO was mostly used to desalinate sea water for mine operations. Only one mine – the closed Homestake gold mine in South Dakota – used RO to treat mine seepage (ICMM 2012). A large zinc-copper ore body near Crandon, Wisconsin, proposed to use RO and Evaporation for treatment of contaminated groundwater from the mine before reusing the water in the mine (Leopold et al. 2001).

ALTERNATIVE TECHNOLOGY

Other technologies considered for mining operations include ion exchange, electrodialysis, and mechanical (vapor compression) evaporators.

Ion Exchange has been used in mining applications to remove heavy metals and other divalent metal cations. Ion exchange resins for nitrate removal depend on the quality of the incoming water. There are three types of ion exchange systems: anionic, cationic, and chelating ion. Potable water influent can be treated for nitrate removal with strong base anion exchange and weak base anion exchange (Jensen 2012). Anions or cations are removed with the resins, producing treated water removed from the resin bed by regeneration with either acid or caustic. Regeneration of ion exchange beds produces a waste stream that has to be disposed of. Regeneration requires the storage of concentrated acids and bases and knowledgeable operators (Chambers 2014). Ion Exchange is generally not feasible or cost effective for treating large volumes of water as would be encountered in the Black Butte Copper Mine Project.

Electrodialysis uses direct electrical current across a stack of alternating cation and anion selective membranes to collect either anions or cations. Electrodialysis Reversal (EDR) units operate under lower pressures and are more tolerant of temperature and pH than RO. However, like RO, EDR units are susceptible to calcium sulfate scaling if pretreatment is inadequate. EDR treatment efficiency in removing dissolved ions does not compare favorably with RO. The amount of water recovered is lower, and a waste brine solution is also produced for disposal (Bowell 2004).

Mechanical vapor recompression evaporators can significantly reduce the waste brine volume; however, they have high maintenance requirements and high capital and operating costs. Mechanical and solar evaporation was considered by Tintina, but rejected based on inefficiency and costs.

The VSEP is a viable technology for volume reduction of the brine. It is not susceptible to calcium sulfate scaling and is more cost effective than mechanical evaporation.

CONCLUSIONS AND RECOMMENDATIONS

In theory, RO can remove 90+ percent of dissolved ions, including nitrate. In reality, the influent water quality and pretreatment determine the actual water recovery. The quality of the treated water modeled by the membrane manufacturer predicts that the proposed RO treatment system would produce water quality for injection below the non-degradation standards. However, the presence of calcium sulfate in the mine water is expected to play a significant role in reducing the water recovery rates and treatment efficiency. Selection and use of a calcium sulfate specific antiscalant would mitigate the impact of calcium sulfate and improve water recovery. The ability of the pretreatment would be critical to achieving the predicted quality of the RO treated water. There are not many technically feasible and non-cost prohibitive methods to reduce water treatment residuals. The VSEP system has been used for treatment of acid mine drainage and appears to be an appropriate method of reducing brine. In conclusion, there are no better alternatives to those proposed in the MOP for treating groundwater inflow and reducing brine volumes.

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APPENDIX H

Technical Memorandum 8

Technical Memorandum 8

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Analysis of the effectiveness of the proposed end of mine flushing of the underground workings to remove oxidation products, including an evaluation of the length of time needed to accomplish this procedure

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as "MOP", with the particular section and page numbers as appropriate.

BACKGROUND

MINERAL SALT ACCUMULATION

Mineral salt accumulation is expected locally on access drift sills, backs, and ribs during the life of mine. Some of the salts would be highly soluble and susceptible to migration into groundwater upon inundation following mine closure.

FLUSH PROGRAM EXTENT

Humidity cell testing indicates that a three- to six-cycle flush program would be needed to wash down salts (MOP Section 7.3.3.6, pp. 428-433). Locally, that could extend to ten cycles. Conservatively, the duration of each cycle across the various zones would lead to a total program length on the order of 1 year.

CURRENT MOP

PHASED RO PERMEATE FLUSHING

The Proponent proposes to flush underground access workings initially with unbuffered RO permeate and subsequently with buffered RO permeate. The unbuffered RO permeate would have a relatively elevated capacity to scavenge solutes, whereas the buffered RO permeate would have a reduced capacity to scavenge solutes from bedrock (MOP Section 7.3.3.6, p. 428; Section 3DEQ [Response to Comments], p. 481).

POST-RINSE GROUNDWATER INUNDATION

Following these rinse phases, groundwater inundation would occur, creating anoxic conditions that are expected to result in groundwater characteristics meeting background conditions.

MONITORING AND REMEDIATION

Groundwater monitoring throughout the closure process would guide the rinsing and any remediation procedures (MOP Section 4.3.2, pp. 381-383; Section 6, pp. 391-406; Section 7.3.3.5, pp. 421-428; Section 7.3.3.6, pp. 428-433; Section 7.3.3.9, p. 435). This has been queried (Smith 2017), and the proposed MOP entails diligent and thorough background, operational, and closure monitoring programs. It would be prudent to allow these state-of-the-art investigations to shape and guide the closure and post-closure plans.

CONSTRUCTION ISSUES

EQUIPMENT DEPLOYMENT AND RINSE PROVISION

The Proponent is considering high-pressure washing of oxidation products and possibly shotcreting exposed high sulfide zones to isolate and immobilize those oxidation products (MOP Section 7.3.3.9, p. 435).

Typical shotcrete is not recommended as a chemical barrier over high sulfide zones. It is relatively permeable and susceptible to sulfate attack.

SUMP STAGING TO RECOVER RINSATE

In addition to the proposed monitor wells (MOP Section 7.3.3.7, p. 434), staging sumps could be appropriate to handle rinsate. It is appropriate to include the concept in the Environmental Impact Statement (EIS), with specific details to be based on the developing conditions during operational and closure monitoring.

EIS ENVIRONMENTAL ISSUES

COMPLIANCE WITH DEQ NON-DEGRADATION CRITERIA

Though the Humidity Cell Test (HCT) program was rigorous, it is appropriate to investigate whether salt build-up on the access and development drift surfaces is an environmental liability with respect to volume, concentration, potential dissolution, precipitation, or reaction to inert compounds, travel times, and distances to potential beneficial use of impacted groundwater. Those investigations are or can be part of the operational and closure water monitoring programs.

ADDITIONAL QUERIES

Increased Solute Loading

The question has been raised as to whether the greater surface area of broken rock, tailing, and open drifts would result in greater solute loading (Jepson 2017). There would be a broken rind around the access drifts, but the extent would be remarkably minimized with controlled blasting techniques and in any event is expected to be no more than a drift radius. Blasting breaks preferentially follow pre-existing fractures, and energy outside the individual blast pattern perimeter would tend to open those rather than introduce new fractures. Pre-splitting or smoothing the shots could virtually eliminate fracturing outside the blast pattern (Langefors and Kihlström 1963). Those techniques or their corollaries – in common use since the 1950s – are typical for permanent drill and blast openings in mining as well as virtually all drill and blast civil infrastructure openings.

The cemented tailing would present little internal surface area. With the overhand mining method, the superjacent fill would be poured directly on the hardened subjacent fill, and there would be no significant gaps between levels. The only air gap would be approximately 1.5 feet on the final level, and that could be readily filled with expansive grout or other media suitable for that application. Thus, the pre-mining naturally fractured rock would be replaced by a relatively tight and massive cemented formation.

It is reasonable to expect that the presented drift surface area would be similar to the pre-mining fracture surface area in the same volume. It could be less, depending on original local fracture frequency.

With these tailings and geology properties and prudent mining, no significant increase in surface area is expected. The essential change would be in exposure to atmosphere, which is proposed to be handled by the multiple flushing cycles.

Flushing Effectiveness

Questions have been raised as to whether oxidation products in fractures, voids between paste backfill and stope backs, and/or within the paste backfill would be effectively flushed out by the proposed rinsing (Jepson 2017). Will they continue to dissolve and bleed out slowly into the groundwater flow paths after active mining ceases, resulting in greater loading rates to the groundwater system than under the pre-mining condition?

Means for field evaluation of flushing effectiveness could be conducted during development and mining, with reasonable time to consider modifications to the closure procedures if needed. The field testing, which can begin relatively early in the mine life, would confirm whether the HCT results of “no significant salt loading” remain valid guidelines.

The post-mining anoxic conditions would significantly reduce or halt the tendency for producing additional salts. The relatively lower permeability of the cemented tailings (MOP Section 2.2.5, pp. 56-61; Table 2-13, p. 60) and low-permeability construction concrete would result in groundwater flow diverting around these structures; therefore, they are not expected to significantly contribute to salt loading of the groundwater.

Non-Degradation Compliance

Questions have been raised as to whether groundwater or surface water non-degradation criteria would be exceeded at some point post-closure (Jepson 2017).

The operational monitoring programs (MOP Section 6.3.1, pp. 391-398; Section 6.3.2, pp. 398-399) would provide years of data, providing opportunities for understanding trends and predicting behavior. The mining and milling processes are designed to prevent exceedances, and the background and operational monitoring are designed to assist in predicting exceedances.

Though testing to date indicates there would be no exceedances post closure, the post-operational closure monitoring for water quality (MOP Section 6.4.2, p. 405)

> … 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.

Nitrogen Flooding

A question has been raised as to whether nitrogen flooding would be suitable control for oxidation on the surfaces of underground openings. The procedure presented (Brown 2017) is:

> At closure, after the plugs are in… starting at the lowest level, flood the workings with low pressure N2 gas to displace oxygen/air moisture and limit oxidation. As that is being done, control fill with polished water. Once the lowest area is full, move on to the next higher. N2/polished water injection and monitoring wells would have to be installed in each, but the wells could be used for water monitoring post closure.

At first pass, this procedure does not eliminate the rinsing or flushing but is an additional action to supplant or augment the eventual groundwater inundation. An initial consideration is the suitability of the rock for gas flooding. Would gas seepage into the rock occur simply due to concentration gradient? Would that reduce or increase gas flooding efficiency? Would pressurization be needed to maintain efficiency?

Some of the wells for N2 and polished water injection would be close to and perhaps east of Sheep Creek in order to reach the lower ore zone and its access drifts. In order to intercept mine openings (16 feet wide at approximate depths from 300 to 1,300 feet), directional drilling would be necessary for both the lower and upper workings, as well as the ramp between them and on toward the portal. Though technically feasible, that adds considerable cost and constraints to the drilling. As injection wells with the attendant tankers and pump rigs, the drill sites would be larger than typical mineral exploration or water monitoring pads.

Nitrogen gas is handled in many industrial settings, even in bulk quantities. Historically, the use of nitrogen gas in the mining industry has been for extinguishing coal mine fires. However, even the fire retarding potential of flooding coal mines with nitrogen gas has not advanced beyond the research phase (Trevits 2009). Safety, skill, and experience may not easily be found for nitrogen flooding. Some of the uncertainties center on the quantity of nitrogen needed, whether onsite production would be beneficial to the use of delivered cryogenic nitrogen, how well the mine is sealed to prevent the escape of the nitrogen and influx of other gases, and the timing.

Nitrogen flooding entails installing all plugs and then drilling/injecting. The Proponent proposed that flushing is done sequentially before the plug construction, with the plugs subsequently contributing to the desired and natural anoxic condition. If the nitrogen is applied following flushing, would it in fact contribute to resolving salt generation and infiltration into groundwater? If flushing is not done before the nitrogen and polished water addition, would those alone achieve salt removal? Since the nitrogen program would be monitored only by remote means (drill holes), could the salt removal be verified?

Would sequential flushing be significantly more efficient than nitrogen flooding simply based on the plug construction timeline? As a very effective asphyxiant, it is not prudent to plan on nitrogen flooding with personnel in the mine, even with plugs above the nitrogen and below the personnel. The use of nitrogen in this application would have to be very reliably engineered to supplant the proposed closure flushing program. The RO permeate closure flushing is comparatively very benign from the perspective of personnel safety.

TECHNICAL APPROACH

CONFIRMATION THAT RINSING IS EFFECTIVE

Rinsate Infiltration

The drifts are not impermeable vessels; they are openings excavated in naturally fractured rock. Whether high pressure washing or inundation is used, what amount of rinsate would infiltrate into the back, ribs, and sill, and escape recovery? With high pressure washing, the rinsate would run to and over the sill to final collection. With inundation, the rinsate would stand or pond on the sill, against the ribs, and then against the back. Would infiltration significantly diminish the effectiveness of rinsing by seeping into the surrounding rock? Could infiltration be monitored and evaluated during the operational testing and design of the rinse procedures?

Rinsate Volume versus Inundation/Groundwater Volume

The predicted duration of rinsing cycles (MOP Section 7.3.3.7, p. 434) is a state of the art hydrological analysis. As queried above, could infiltration be monitored and evaluated during the operational testing and design of the rinse procedures? This could refine the model analysis and provide field scale guidance in designing rinse procedures.

Local versus Extensive Flushing

There is a reasonable expectation that surface oxidation would be localized to high-sulfur zones within the rock formations. The investigations during mine operations should include evaluating local versus extensive flushing aspects of the proposed rinsing program.

Salt Generation Time versus Salt Dissolution Time

When operational field testing can begin, it would be appropriate to investigate the efficacy of pressure washing versus inundation. An aspect of that could be the salt generation rate, which may resume or continue between high pressure wash cycles. That phenomenon could indicate that inundation is the most appropriate rinsing technique, or a combination of local pressure washing followed by inundation for subsequent rinses.

Implementation Cost

The implementation cost of closure flushing has been questioned (Freshman 2017). The Proponent is asked to provide that support. If appropriate, costs can be developed by the technical memo author(s) or other third party in either cursory or detailed analysis based on heads, volumes, equipment, and personnel. Conceptually, flushing as proposed appears to be a relatively low-cost approach. Apart from the hydrologic plugs, the essential material handled is water, which already is part of the process stream.

Implementation Duration

The duration of closure flushing has been questioned (Jepson 2017). The most conservative estimate (MOP Section 7.3.3.7, p. 434) is between 12 and 13 months. Post-closure monitoring would continue after the flushing program (MOP Section 6.4.2, p. 405).

MINIMIZE/ELIMINATE SALT GENERATION

Since the generation of the mineral salts is expected to be related to oxidation, eliminating or minimizing exposure of susceptible high sulfur zones to the mine air flow should be considered.

An additional aspect of operational testing could be to investigate whether preventive fillings or coverings could effectively minimize or eliminate salt generation. In various mining, tunneling, and infrastructure settings, these have been used to good effect for controlling gas, vapor, and water inflow. Using them as a low-pressure airflow barrier can readily be investigated.

Below are common items in underground construction and can be used separately or in combination, dependent on the specific application.

Grout Injection

Grout rings have a long and successful history in control of water and weak ground. In a high-sulfur zone, they could be used to flood and encapsulate that rock within a distance of several meters from the opening surface – sill, ribs, and back. If done with or soon after initial excavation, grout rings might eliminate much of the potential salt generation. Injected grout typically is packed or staged to prevent blowouts to the collar (surface). In this application, it would be appropriate to follow the grouting with concrete or shotcrete to seal the opening surface.

Concrete

Alternatively, concrete lining could be formed and poured to a sufficient thickness to retard or eliminate salt generation. Admixes to reduce permeability are recommended for this application.

A concrete lining would entail sub-excavation of the entire drift perimeter to establish the lining without encroaching on the drift cross-section. The sill must be taken deep enough to form and armor a running surface, which would withstand the mine vehicular traffic.

Constructing a concrete lining over grout rings could provide substantial reduction in the potential to oxidize high sulfur ground.

Shotcrete

Shotcrete has a long history in underground mining and construction for mechanical support of soil and rock. If admixtures to minimize permeability are used and applied thickly enough (typically in multiple passes), it can retard passage of liquids and gases. Shotcrete is aerated in application and typically is not an effective barrier to liquid or gases.

Shotcrete typically is of lesser utility on the sill of active drifts, as most configurations are not designed for vehicle traffic.

Sprayable Membranes

Synthetic sprayable membranes have applications as atmospheric and liquid barriers. In a mine setting, they typically are protected with either shotcrete or concrete. Across the sill, concrete is more appropriate for protecting against vehicular traffic. Conceptually, these membranes are a spray application of moisture/vapor/gas barriers used in conventional construction.

Rock Dusting

Rock dusting with limestone and/or lime could be investigated as a preliminary control measure in neutralizing the sulfur reactions, which initiate on exposure to the air. Though mine water treatment is common in plant settings (Geldenhuys et al. 2003), the drift setting with dry application could warrant consideration as the mine development were to proceed.

Rock dust is envisioned as an immediate application upon exposure of a high sulfur zone. Even if repetitive applications would be needed, it is a field scale investigation that may diminish formation of deleterious compounds but which would not preclude or impede adoption of closure flushing.

CONCLUSIONS AND RECOMMENDATIONS

Closure Flushing of Access and Ancillary Openings

The hydrologic and geochemical analyses to date indicate that flushing the salt out of access and ancillary openings is a feasible and appropriate method of reaching groundwater discharge compliance.

Salt-laden rinsate infiltration should be analyzed in detail prior to commitment to closure flushing as the primary control for achieving post-closure water quality.

SHOTCRETE ALONE IS NOT RECOMMENDED

Shotcrete alone is suggested by the proponent (MOP Section 7.3.3.9, p. 435). Shotcrete alone is not recommended as a chemical barrier over high sulfide zones. Even vulcanized shotcrete can be susceptible to sulfate attack, losing adhesion to the rock surface and subsequently cracking or spalling.

MINIMIZE/ELIMINATE SALT GENERATION

The Proponent is asked to evaluate whether isolating potential salt generation zones is feasible and would eliminate their impact on groundwater discharge. Those evaluations could commence during the development and proceed through the operational phases, with the object of determining whether salt generation could be minimized or prevented during the life of mine, thus eliminating the need for or reducing the extent of closure flushing.

Various techniques are discussed above.

CEMENTED TAILINGS BACKFILL OF ACCESS OPENINGS

The proponent is asked to evaluate or confirm evaluation of the suitability of flushing as opposed to select plugs of salt zones or complete cemented tailings fill of access and ancillary openings.

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APPENDIX I

Baseline Surface Water Quality

Table 1 Water Quality Summary Statistics, SW-1

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			46	46	0.5	13.3	1.5	0.8	1.0	1.6	1.8
Flow	Cubic Ft Sec			55	55	8.8	613	72.2	19.8	40.3	103	92.6
pH - Field	s.u.			65	65	5.3	8.7	7.9	7.8	8.1	8.3	0.7
Field Specific Conductivity	umhos/cm			66	66	176	363	284	239	304	321	54.2
Water Temperature	Deg C			66	66	-1.0	15.5	5.0	0.1	4.1	9.1	4.9
Dissolved Oxygen	mg/L	6.5		66	66	3.9	15.0	11.1	10.1	10.8	12.3	1.9
Physical Parameters												
Total Dissolved Solids	mg/L			70	70	104	227	165	147	175	186	28.6
Total Suspended Solids	mg/L			64	26	<4	50.0	10.3	4.0	9.5	10.3	9.1
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			70	70	87.0	200	150	130	160	170	32.4
Bicarbonate as HCO3	mg/L			7	7	110	220	167	125	190	200	46.1
Carbonate as CO3	mg/L			7	5	<1	11.0	6.1	2.5	8.0	9.0	4.1
Chloride	mg/L			70	69	<1	5.0	1.5	1.0	1.0	2.0	0.7
Fluoride	mg/L		4	70	20	<0.1	0.2	0.1	0.1	0.1	0.1	0.01
Sulfate	mg/L			70	70	2.0	18.0	5.2	4.0	5.0	6.3	2.2
Hardness as CaCO3	mg/L			69	68	<7	199	146	114	162	173	37.1
Calcium (DIS)	mg/L			70	70	22.0	55.0	41.3	34.3	45.5	48.0	9.1
Magnesium (DIS)	mg/L			70	70	6.0	15.0	10.9	9.0	12.0	13.0	2.5
Potassium (DIS)	mg/L			70	65	<1	3.0	1.1	1.0	1.0	1.0	0.5
Sodium (DIS)	mg/L			70	70	1.0	3.0	2.2	2.0	2.0	2.0	0.4
Nutrients												
Nitrate + Nitrite as N	mg/L	10		70	31	<0.01	0.2	0.03	0.01	0.01	0.03	0.04
Kjeldahl Nitrogen as N	mg/L			12	5	<0.5	4.5	1.5	0.5	0.5	2.5	1.4
Total Persulfate Nitrogen	mg/L			43	36	<0.003	1.1	0.2	0.08	0.1	0.2	0.2
Phosphorus (TOT)	mg/L			53	49	<0.003	0.09	0.02	0.01	0.01	0.02	0.02
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		70	33	<0.009	0.3	0.06	0.009	0.01	0.06	0.09
Aluminum (TRC)	mg/L			8	8	0.06	2.1	0.6	0.10	0.1	0.9	0.9
Antimony (DIS)	mg/L		0.0056	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			70	0	<0.0005	0.005	0.0009	0.0005	0.0005	0.0005	0.0009
Arsenic (DIS)	mg/L	0.15	0.01	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			70	11	<0.001	0.003	0.001	0.001	0.001	0.001	0.0006
Barium (DIS)	mg/L		1	4	4	0.08	0.1	0.1	0.09	0.09	0.1	0.01
Barium (TRC)	mg/L			70	70	0.08	0.1	0.1	0.1	0.1	0.1	0.010
Beryllium (DIS)	mg/L		0.004	4	0	<0.001	0.001	0.001	0.00	0.001	0.001	0
Beryllium (TRC)	mg/L			70	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00006
Cadmium (DIS)	mg/L	0.00025	0.005	4	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			70	5	<0.00003	0.0002	0.00004	0.00003	0.00003	0.00003	0.00003
Chromium (DIS)	mg/L		0.1	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			70	3	<0.001	0.01	0.009	0.01	0.010	0.010	0.003
Cobalt (DIS)	mg/L			4	0	<0.01	0.01	0.01	0.01	0.010	0.010	0
Cobalt (TRC)	mg/L			70	0	<0.005	0.01	0.01	0.01	0.010	0.010	0.001
Copper (DIS)	mg/L	0.00285	1.3	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			70	10	<0.001	0.008	0.002	0.002	0.002	0.002	0.0008
Iron (DIS)	mg/L			4	1	<0.03	0.04	0.03	0.03	0.03	0.03	0.005
Iron (TRC)	mg/L	1		70	70	0.1	1.9	0.4	0.2	0.2	0.6	0.4
Lead (DIS)	mg/L	0.000545	0.015	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			70	21	<0.0003	0.002	0.0004	0.0003	0.0003	0.0005	0.0002
Manganese (DIS)	mg/L			4	4	0.006	0.009	0.007	0.006	0.007	0.008	0.002
Manganese (TRC)	mg/L			70	70	0.009	0.08	0.02	0.01	0.02	0.02	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	4	0	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			70	17	<0.000005	0.00002	0.000007	0.000005	0.000005	0.000006	0.000004
Molybdenum (DIS)	mg/L			4	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			70	0	<0.001	0.005	0.002	0.002	0.002	0.002	0.001
Nickel (DIS)	mg/L	0.0161	0.1	4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			70	15	<0.001	0.01	0.002	0.001	0.001	0.002	0.003
Selenium (DIS)	mg/L	0.005	0.05	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			70	0	<0.0002	0.001	0.0003	0.0002	0.0002	0.0002	0.0003
Silver (DIS)	mg/L		0.1	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			70	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	0.0001
Strontium (DIS)	mg/L		4	4	3	<0.1	0.1	0.1	0.1	0.1	0.1	0
Strontium (TRC)	mg/L			70	65	<0.0779	0.1	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	4	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			70	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	4	3	<0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.00005
Uranium (TRC)	mg/L			70	9	<0.0003	0.008	0.006	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			70	27	<0.002	0.01	0.004	0.002	0.002	0.005	0.003

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 2 Water Quality Summary Statistics, SW-2

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			38	38	0.2	1.7	0.8	0.5	0.8	1.2	0.4
Flow	Cubic Ft Sec			42	42	4.0	250	52.1	13.8	29.9	93.4	52.5
pH - Field	s.u.			64	64	6.5	8.7	7.9	7.7	8.1	8.3	0.5
Field Specific Conductivity	umhos/cm			66	66	156	388	279	236	295	322	55.0
Water Temperature	Deg C			66	66	-1.0	15.8	4.9	0.003	3.3	9.9	5.1
Dissolved Oxygen	mg/L	6.5		66	66	6.35	16.2	11.1	9.94	10.8	12.1	1.8
Physical Parameters												
Total Dissolved Solids	mg/L			72	72	112	225	168	160	175	186	26.7
Total Suspended Solids	mg/L			67	19	<4	105	10.6	4.0	10.0	10.0	13.6
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			72	72	80.0	200	155	140	160	173	28.7
Bicarbonate as HCO3	mg/L			9	9	98.0	220	178	140	200	210	43.1
Carbonate as CO3	mg/L			9	8	<1	11.0	7.2	6.0	7.0	11.0	3.4
Chloride	mg/L			72	71	<1	5.0	1.4	1.0	1.0	2.0	0.7
Fluoride	mg/L		4	72	1	<0.1	0.4	0.1	0.1	0.1	0.1	0.04
Sulfate	mg/L			72	72	2.0	9.0	4.9	4.0	4.8	6.0	1.5
Hardness as CaCO3	mg/L			71	70	<7	202	151	131	159	173	34.7
Calcium (DIS)	mg/L			72	72	21.0	58.0	43.5	37.8	46.0	49.3	8.4
Magnesium (DIS)	mg/L			72	72	5.0	15.0	11.0	9.8	12.0	12.0	2.2
Potassium (DIS)	mg/L			72	67	<1	2.0	1.0	1.0	1.0	1.0	0.1
Sodium (DIS)	mg/L			72	72	1.0	3.0	2.0	2.0	2.0	2.0	0.3
Nutrients												
Nitrate + Nitrite as N	mg/L	10		72	34	<0.01	0.1	0.03	0.01	0.01	0.05	0.04
Kjeldahl Nitrogen as N	mg/L			14	5	<0.5	3.6	1.4	0.5	0.5	2.4	1.3
Total Persulfate Nitrogen	mg/L			41	35	<0.003	1.4	0.2	0.06	0.09	0.2	0.3
Phosphorus (TOT)	mg/L			54	46	<0.003	0.2	0.02	0.01	0.01	0.02	0.03
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		72	32	<0.009	0.4	0.04	0.009	0.01	0.05	0.07
Aluminum (TRC)	mg/L			8	8	0.0500	2.7	0.5	0.07	0.1	0.4	0.9
Antimony (DIS)	mg/L		0.0056	6	0	<0.003	0.003	0.003	0.003	0.003	0.003	0.0
Antimony (TRC)	mg/L			72	0	<0.0005	0.005	0.0008	0.0005	0.0005	0.0005	0.0009
Arsenic (DIS)	mg/L	0.15	0.01	6	0	<0.003	0.003	0.003	0.003	0.003	0.003	0.0
Arsenic (TRC)	mg/L			72	1	<0.001	0.003	0.001	0.001	0.001	0.001	0.0006
Barium (DIS)	mg/L		1	6	6	0.0770	0.1	0.09	0.08	0.08	0.09	0.01
Barium (TRC)	mg/L			72	72	0.0700	0.1	0.09	0.09	0.09	0.1	0.01
Beryllium (DIS)	mg/L		0.004	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Beryllium (TRC)	mg/L			72	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00006
Cadmium (DIS)	mg/L	0.00025	0.005	6	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.0
Cadmium (TRC)	mg/L			72	5	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00003	0.00002
Chromium (DIS)	mg/L		0.1	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Chromium (TRC)	mg/L			72	1	<0.001	0.01	0.008	0.01	0.01	0.01	0.003
Cobalt (DIS)	mg/L			6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Cobalt (TRC)	mg/L			72	0	<0.005	0.01	0.010	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Copper (TRC)	mg/L			72	6	<0.001	0.004	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			6	3	<0.03	0.04	0.03	0.03	0.03	0.04	0.005
Iron (TRC)	mg/L	1		72	72	0.0900	2.5	0.3	0.1	0.2	0.3	0.4
Lead (DIS)	mg/L	0.000545	0.015	6	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0
Lead (TRC)	mg/L			72	16	<0.0003	0.002	0.0004	0.0003	0.0003	0.0004	0.0002
Manganese (DIS)	mg/L			6	4	<0.005	0.01	0.008	0.005	0.007	0.008	0.003
Manganese (TRC)	mg/L			72	72	0.00600	0.1	0.01	0.008	0.01	0.01	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	6	0	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0
Mercury (TRC)	mg/L			72	11	<0.000005	0.00006	0.000007	0.000005	0.000005	0.000005	0.000006
Molybdenum (DIS)	mg/L			6	0	<0.005	0.005	0.005	0.005	0.005	0.005	0.0
Molybdenum (TRC)	mg/L			72	0	<0.001	0.005	0.002	0.002	0.002	0.002	0.001
Nickel (DIS)	mg/L	0.0161	0.1	6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Nickel (TRC)	mg/L			72	13	<0.001	0.01	0.002	0.001	0.001	0.001	0.003
Selenium (DIS)	mg/L	0.005	0.05	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Selenium (TRC)	mg/L			72	0	<0.0002	0.001	0.0003	0.0002	0.0002	0.0002	0.0003
Silver (DIS)	mg/L		0.1	6	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0
Silver (TRC)	mg/L			72	0	<0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0001
Strontium (DIS)	mg/L		4	6	4	<0.1	0.1	0.1	0.1	0.1	0.1	0.0
Strontium (TRC)	mg/L			72	69	<0.0818	0.2	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	6	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0.0
Thallium (TRC)	mg/L			72	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0
Uranium (DIS)	mg/L		0.03	6	3	<0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.00004
Uranium (TRC)	mg/L			72	8	<0.0003	0.008	0.006	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Zinc (TRC)	mg/L			72	22	<0.002	0.01	0.004	0.002	0.002	0.005	0.003

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 3 Water Quality Summary Statistics, SW-3

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			15	15	0.1	1.0	0.5	0.4	0.5	0.6	0.2
Flow	Cubic Ft Sec			21	21	0.03	4.9	0.4	0.08	0.1	0.3	1.0
pH - Field	s.u.			25	25	7.9	8.7	8.3	8.2	8.3	8.4	0.2
Field Specific Conductivity	umhos/cm			25	25	269	408	373	363	383	393	35.7
Water Temperature	Deg C			24	24	0.01	14.5	7.8	2.2	9.4	12.1	5.0
Dissolved Oxygen	mg/L	6.5		25	25	6.0	13.4	10.2	9.4	10.0	11.0	1.7
Physical Parameters												
Total Dissolved Solids	mg/L			28	28	152	235	214	209	215	224	16.3
Total Suspended Solids	mg/L			25	10	<4	14	7.9	5.0	10.0	10.0	3.1
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			28	28	150	210	197	190	200	200	12.5
Bicarbonate as HCO3	mg/L			7	7	180	240	224	225	230	235	20.7
Carbonate as CO3	mg/L			7	7	2.0	9.0	7.0	6.5	8.0	8.5	2.4
Chloride	mg/L			28	26	<1	2.0	1.4	1.0	1.0	2.0	0.5
Fluoride	mg/L		4	28	28	0.1	0.2	0.2	0.2	0.2	0.2	0.03
Sulfate	mg/L			28	28	5.0	24.0	15.3	12.0	15.0	18.3	5.0
Hardness as CaCO3	mg/L			27	27	139	225	206	201	213	219	19.5
Calcium (DIS)	mg/L			28	28	31.0	50.0	45.6	45.0	46.0	48.0	4.14
Magnesium (DIS)	mg/L			28	28	15.0	25.0	22.3	21.0	23.0	24.0	2.25
Potassium (DIS)	mg/L			28	25	<1	2.0	1.0	1.0	1.0	1.0	0.2
Sodium (DIS)	mg/L			28	28	2.00	2.0	2.0	2.0	2.0	2.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		28	25	<0.01	0.1	0.05	0.04	0.05	0.06	0.03
Kjeldahl Nitrogen as N	mg/L			4	1	<0.5	2.2	0.9	0.5	0.5	0.9	0.9
Total Persulfate Nitrogen	mg/L			12	11	<0.04	0.2	0.1	0.1	0.1	0.2	0.06
Phosphorus (TOT)	mg/L			16	15	<0.004	0.04	0.01	0.01	0.01	0.02	0.007
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		28	3	<0.009	0.07	0.02	0.009	0.009	0.01	0.01
Aluminum (TRC)	mg/L			6	5	<0.03	0.7	0.3	0.1	0.2	0.6	0.3
Antimony (DIS)	mg/L		0.0056	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			28	0	<0.0005	0.005	0.001	0.0005	0.0005	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			28	0	<0.001	0.003	0.001	0.001	0.001	0.001	0.0008
Barium (DIS)	mg/L		1	5	5	0.1	0.1	0.1	0.1	0.1	0.1	0.01
Barium (TRC)	mg/L			28	28	0.1	0.2	0.1	0.1	0.2	0.2	0.01
Beryllium (DIS)	mg/L		0.004	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			28	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00008
Cadmium (DIS)	mg/L	0.00025	0.005	5	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			28	0	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00003	0.00002
Chromium (DIS)	mg/L		0.1	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			28	0	<0.001	0.01	0.008	0.004	0.01	0.01	0.004
Cobalt (DIS)	mg/L			5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			28	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.0009
Copper (DIS)	mg/L	0.00285	1.3	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			28	5	<0.001	0.003	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			5	0	<0.03	0.03	0.03	0.03	0.03	0.03	0
Iron (TRC)	mg/L	1		28	28	0.0400	1.1	0.2	0.09	0.2	0.2	0.2
Lead (DIS)	mg/L	0.000545	0.015	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			28	16	<0.0003	0.003	0.0007	0.0003	0.0004	0.0006	0.0007
Manganese (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Manganese (TRC)	mg/L			28	11	<0.005	0.2	0.01	0.005	0.005	0.007	0.04
Mercury (DIS)	mg/L	0.00091	0.00005	5	1	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0
Mercury (TRC)	mg/L			28	2	<0.000005	0.00001	0.000006	0.000005	0.000005	0.000005	0.000002
Molybdenum (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			28	0	<0.001	0.005	0.003	0.002	0.002	0.003	0.001
Nickel (DIS)	mg/L	0.0161	0.1	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			28	0	<0.001	0.01	0.003	0.001	0.001	0.001	0.004
Selenium (DIS)	mg/L	0.005	0.05	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			28	5	<0.0002	0.001	0.0004	0.0002	0.0002	0.0006	0.0003
Silver (DIS)	mg/L		0.1	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			28	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	5	0	<0.1	0.1	0.1	0.1	0.1	0.1	0
Strontium (TRC)	mg/L			28	25	<0.0838	0.1	0.1	0.1	0.1	0.1	0.00914
Thallium (DIS)	mg/L		0.00024	5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			28	3	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00004
Uranium (DIS)	mg/L		0.03	5	5	0.00050	0.0006	0.0005	0.0005	0.0005	0.0006	0.00005
Uranium (TRC)	mg/L			28	9	<0.0005	0.008	0.006	0.00070	0.008	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			28	15	<0.002	0.03	0.006	0.002	0.003	0.009	0.006

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 4 Water Quality Summary Statistics, SW-4

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			4	4	0.3	2.0	1.5	1.4	1.9	2.0	0.8
Flow	Cubic Ft Sec			23	23	0.004	2.0	0.2	0.01	0.03	0.2	0.4
pH - Field	s.u.			26	26	7.5	8.7	8.0	7.9	8.0	8.2	0.3
Field Specific Conductivity	umhos/cm			26	26	237	390	351	343	359	374	33.5
Water Temperature	Deg C			26	26	0.08	15.0	7.4	1.5	9.0	12.5	5.3
Dissolved Oxygen	mg/L	6.5		26	26	5.4	13.7	9.6	8.5	9.6	10.7	1.9
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 5 Water Quality Summary Statistics, SW-5

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			1	1	0.9	0.9	0.9	0.9	0.9	0.9	NA
Flow	Cubic Ft Sec			5	5	0.4	4.7	1.4	0.5	0.7	0.8	1.9
pH - Field	s.u.			5	5	7.3	8.2	7.6	7.5	7.5	7.6	0.3
Field Specific Conductivity	umhos/cm			5	5	49.0	60.0	52.8	50.0	50.0	55.0	4.7
Water Temperature	Deg C			5	5	0.29	12.1	6.0	2.9	6.9	7.8	4.6
Dissolved Oxygen	mg/L	6.5		5	5	8.5	14.0	10.6	9.4	9.7	11.4	2.2
Physical Parameters												
Total Dissolved Solids	mg/L			5	5	66.0	123	90.2	74.0	86.0	102	22.8
Total Suspended Solids	mg/L			4	2	<10	107	38.0	10.0	17.5	45.5	46.5
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			5	5	24.0	27.0	25.8	25.0	26.0	27.0	1.3
Bicarbonate as HCO3	mg/L			2	2	32.0	33.0	32.5	32.3	32.5	32.8	0.7
Carbonate as CO3	mg/L			2	0	<1	1.0	1.0	1.0	1.0	1.0	0.0
Chloride	mg/L			5	0	<1	1.0	1.0	1.0	1.0	1.0	0.0
Fluoride	mg/L		4	5	0	<0.1	0.1	0.1	0.1	0.1	0.1	0.0
Sulfate	mg/L			5	3	<1	2.0	1.3	1.0	1.0	1.5	0.4
Hardness as CaCO3	mg/L			5	5	19.0	26.0	24.6	26.0	26.0	26.0	3.1
Calcium (DIS)	mg/L			5	5	6.0	7.0	6.8	7.0	7.0	7.0	0.4
Magnesium (DIS)	mg/L			5	5	1.0	2.0	1.8	2.0	2.0	2.0	0.4
Potassium (DIS)	mg/L			5	5	1.0	2.0	1.6	1.0	2.0	2.0	0.5
Sodium (DIS)	mg/L			5	5	1.0	1.0	1.0	1.0	1.0	1.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		5	4	<0.01	0.2	0.06	0.01	0.04	0.06	0.08
Kjeldahl Nitrogen as N	mg/L			1	1	0.7	0.7	0.7	0.7	0.7	0.7	NA
Total Persulfate Nitrogen	mg/L			1	1	1.20	1.2	1.2	1.2	1.2	1.2	NA
Phosphorus (TOT)	mg/L			2	2	0.04	0.2	0.1	0.1	0.1	0.1	0.1
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		5	5	0.2	3.1	1.3	0.4	0.7	2.1	1.2
Aluminum (TRC)	mg/L			2	2	0.7	1.0	0.8	0.8	0.8	0.8	0.2
Antimony (DIS)	mg/L		0.0056	1	0	<0.003	0.003	0.003	0.003	0.003	0.003	NA
Antimony (TRC)	mg/L			5	0	<0.0005	0.003	0.002	0.001	0.001	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	1	0	<0.003	0.003	0.003	0.003	0.003	0.003	NA
Arsenic (TRC)	mg/L			5	3	0.001	0.004	0.003	0.002	0.003	0.003	0.001
Barium (DIS)	mg/L		1	1	1	0.2	0.2	0.2	0.2	0.2	0.2	NA
Barium (TRC)	mg/L			5	5	0.2	0.3	0.2	0.2	0.2	0.2	0.08
Beryllium (DIS)	mg/L		0.004	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Beryllium (TRC)	mg/L			5	0	<0.0008	0.001	0.0009	0.0008	0.0008	0.001	0.0001
Cadmium (DIS)	mg/L	0.00025	0.005	1	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	NA
Cadmium (TRC)	mg/L			5	1	<0.00003	0.0002	0.00008	0.00003	0.00008	0.00008	0.00007
Chromium (DIS)	mg/L		0.1	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Chromium (TRC)	mg/L			5	1	<0.001	0.01	0.006	0.001	0.01	0.01	0.005
Cobalt (DIS)	mg/L			1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Cobalt (TRC)	mg/L			5	0	0.01	0.01	0.01	0.01	0.01	0.01	0.0
Copper (DIS)	mg/L	0.00285	1.3	1	1	0.002	0.002	0.002	0.002	0.002	0.002	NA
Copper (TRC)	mg/L			5	5	0.003	0.009	0.004	0.003	0.003	0.004	0.003
Iron (DIS)	mg/L			1	1	0.2	0.2	0.2	0.2	0.2	0.2	NA
Iron (TRC)	mg/L	1		5	5	0.5	6.0	2.1	0.7	1.4	1.9	2.257
Lead (DIS)	mg/L	0.000545	0.015	1	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	NA
Lead (TRC)	mg/L			5	3	<0.0005	0.005	0.001	0.0005	0.0005	0.0007	0.002
Manganese (DIS)	mg/L			1	1	0.019	0.02	0.02	0.02	0.02	0.02	NA
Manganese (TRC)	mg/L			5	5	0.011	0.2	0.05	0.01	0.01	0.037	0.066
Mercury (DIS)	mg/L	0.00091	0.00005	1	1	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	NA
Mercury (TRC)	mg/L			5	4	<0.0000062	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum (DIS)	mg/L			1	0	<0.005	0.005	0.005	0.005	0.005	0.005	NA
Molybdenum (TRC)	mg/L			5	0	<0.002	0.005	0.003	0.002	0.002	0.005	0.002
Nickel (DIS)	mg/L	0.0161	0.1	1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Nickel (TRC)	mg/L			5	3	<0.003	0.01	0.007	0.004	0.008	0.01	0.003
Selenium (DIS)	mg/L	0.005	0.05	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Selenium (TRC)	mg/L			5	2	<0.0002	0.001	0.0006	0.0002	0.0004	0.001	0.0004
Silver (DIS)	mg/L		0.1	1	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	NA
Silver (TRC)	mg/L			5	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0002
Strontium (DIS)	mg/L		4	1	0	<0.1	0.1	0.1	0.1	0.1	0.1	NA
Strontium (TRC)	mg/L			5	3	<0.028	0.1	0.06	0.03	0.03	0.1	0.04
Thallium (DIS)	mg/L		0.00024	1	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	NA
Thallium (TRC)	mg/L			5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0.0
Uranium (DIS)	mg/L		0.03	1	0	<0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	NA
Uranium (TRC)	mg/L			5	0	<0.0003	0.008	0.003	0.0003	0.0003	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Zinc (TRC)	mg/L			5	4	<0.007	0.03	0.01	0.01	0.01	0.02	0.010

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 6 Water Quality Summary Statistics, SW-6

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			1	1	0.9	0.9	0.9	0.9	0.9	0.9	NA
Flow	Cubic Ft Sec			23	23	0.04	4.1	0.4	0.1	0.2	0.2	0.8
pH - Field	s.u.			27	27	6.7	8.7	8.0	8.0	8.1	8.2	0.4
Field Specific Conductivity	umhos/cm			27	27	249	433	387	371	393	411	36.1
Water Temperature	Deg C			27	27	-0.03	18.3	7.7	1.5	6.8	13.1	6.1
Dissolved Oxygen	mg/L	6.5		27	27	5.8	14.2	9.7	8.5	9.9	11.0	1.9
Physical Parameters												
Total Dissolved Solids	mg/L			28	28	162	254	222	216	221	233	18.4
Total Suspended Solids	mg/L			23	16	<4	107	20.0	10.0	10.0	19.0	26.7
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			28	28	140	240	213	208	220	223	19.6
Bicarbonate as HCO3	mg/L			7	7	220	260	246	245	250	250	12.7
Carbonate as CO3	mg/L			7	7	4.0	13.0	9.1	7.0	9.0	12.0	3.3
Chloride	mg/L			28	8	<1	2.0	1.0	1.0	1.0	1.0	0.189
Fluoride	mg/L		4	28	26	<0.1	0.2	0.16	0.1	0.2	0.2	0.05
Sulfate	mg/L			28	28	6.0	34.0	11.5	8.8	9.5	13.0	5.4
Hardness as CaCO3	mg/L			28	28	119	239	212	211	216	227	24.3
Calcium (DIS)	mg/L			28	28	28.0	54.0	49.3	49.0	50.0	52.3	5.3
Magnesium (DIS)	mg/L			28	28	12.0	26.0	21.6	21.0	22.0	23.0	2.8
Potassium (DIS)	mg/L			28	14	<1	3.0	1.1	1.0	1.0	1.0	0.448
Sodium (DIS)	mg/L			28	28	2.0	3.0	2.9	3.0	3.0	3.0	0.315
Nutrients												
Nitrate + Nitrite as N	mg/L	10		28	25	<0.01	0.1	0.05	0.02	0.05	0.07	0.03
Kjeldahl Nitrogen as N	mg/L			5	1	<0.5	3.4	1.1	0.5	0.5	0.5	1.3
Total Persulfate Nitrogen	mg/L			11	11	0.1	0.4	0.2	0.1	0.2	0.2	0.09
Phosphorus (TOT)	mg/L			16	16	0.01	0.04	0.02	0.02	0.02	0.03	0.01
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		28	1	<0.009	0.03	0.01	0.009	0.009	0.02	0.009
Aluminum (TRC)	mg/L			7	7	0.03	0.2	0.1	0.1	0.1	0.2	0.05
Antimony (DIS)	mg/L		0.0056	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			28	0	<0.0005	0.005	0.001	0.0005	0.0005	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			28	0	<0.001	0.003	0.002	0.001	0.001	0.002	0.001
Barium (DIS)	mg/L		1	5	5	0.107	0.1	0.1	0.1	0.1	0.1	0.007
Barium (TRC)	mg/L			28	28	0.091	0.2	0.1	0.1	0.1	0.1	0.028
Beryllium (DIS)	mg/L		0.004	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			28	0	<0.0008	0.001	0.0009	0.0008	0.0008	0.0009	0.00009
Cadmium (DIS)	mg/L	0.00025	0.005	5	0	<0.00008	0.00008	0.0001	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			28	2	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00006	0.00002
Chromium (DIS)	mg/L		0.1	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			28	0	<0.001	0.01	0.007	0.001	0.01	0.01	0.004
Cobalt (DIS)	mg/L			5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			28	0	<0.005	0.01	0.010	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			28	1	<0.001	0.002	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			5	3	<0.03	0.05	0.04	0.03	0.04	0.04	0.008
Iron (TRC)	mg/L	1		28	28	0.05	1.9	0.4	0.2	0.4	0.5	0.4
Lead (DIS)	mg/L	0.000545	0.015	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			28	10	<0.0003	0.002	0.0005	0.0003	0.0004	0.0005	0.0004
Manganese (DIS)	mg/L			5	5	0.005	0.01	0.008	0.005	0.007	0.01	0.003
Manganese (TRC)	mg/L			28	26	<0.005	0.07	0.02	0.01	0.02	0.02	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	5	0	<0.00001	0.00001	0.0000	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			28	4	<0.000005	0.00002	0.00001	0.000005	0.000005	0.00001	0.000004
Molybdenum (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			28	0	<0.001	0.005	0.003	0.002	0.002	0.005	0.001
Nickel (DIS)	mg/L	0.0161	0.1	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			28	2	<0.001	0.01	0.003	0.001	0.001	0.004	0.004
Selenium (DIS)	mg/L	0.005	0.05	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			28	7	<0.0002	0.001	0.0005	0.0002	0.0002	0.001	0.0004
Silver (DIS)	mg/L		0.1	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			28	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	5	5	0.1	0.2	0.2	0.2	0.2	0.2	0.04
Strontium (TRC)	mg/L			28	28	0.1	0.3	0.2	0.2	0.2	0.2	0.04
Thallium (DIS)	mg/L		0.00024	5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			28	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	5	5	0.0006	0.0007	0.0006	0.0006	0.0006	0.0007	0.00005
Uranium (TRC)	mg/L			28	10	<0.0005	0.008	0.0054	0.0007	0.008	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			28	12	<0.002	0.03	0.006	0.002	0.003	0.01	0.006

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 7 Water Quality Summary Statistics, SW-8

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			17	17	0.2	2.1	0.6	0.3	0.4	0.6	0.5
Flow	Cubic Ft Sec			20	20	0.09	9.1	1.4	0.2	0.5	1.1	2.2
pH - Field	s.u.			23	23	6.9	8.7	7.9	7.8	8	8.2	0.4
Field Specific Conductivity	umhos/cm			23	23	164	445	377	338	408	431	80.4
Water Temperature	Deg C			23	23	-0.2	16.1	6.5	0.04	6.9	11.0	5.8
Dissolved Oxygen	mg/L	6.5		23	23	5.6	13.5	10.3	9.4	10.1	11.1	1.8
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 8 Water Quality Summary Statistics, SW-9

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			8	8	1.3	2.1	1.9	2.0	2.0	2.0	0.3
Flow	Cubic Ft Sec			25	25	0.3	12.7	1.4	0.4	0.7	1.7	2.5
pH - Field	s.u.			26	26	7.7	8.5	8.2	8.1	8.2	8.3	0.2
Field Specific Conductivity	umhos/cm			26	26	335	474	418	409	424	435	28.5
Water Temperature	Deg C			26	26	0.5	14.9	6.0	1.8	5.2	10.1	4.7
Dissolved Oxygen	mg/L	6.5		26	26	5.7	14.9	10.5	10.1	10.5	11.4	1.8
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 9 Water Quality Summary Statistics, SW-10

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			16	16	0.7	1.2	0.9	0.8	0.9	1.0	0.2
Flow	Cubic Ft Sec			20	20	0.2	15.2	1.45	0.3	0.5	1.4	3.3
pH - Field	s.u.			22	22	7.8	8.8	8.3	8.2	8.3	8.5	0.2
Field Specific Conductivity	umhos/cm			22	22	353	438	413	410	417	425	20.1
Water Temperature	Deg C			21	21	0.02	18.6	8.5	4.7	6.4	13.9	6.5
Dissolved Oxygen	mg/L	6.5		22	22	6.6	13.0	10.4	9.9	10.7	11.1	1.6
Physical Parameters												
Total Dissolved Solids	mg/L			2	2	236	249	243	239	243	246	9.2
Total Suspended Solids	mg/L			2	2	6.0	38.0	22.0	14.0	22.0	30.0	22.6
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			2	2	210	220	215	213	215	218	7.1
Bicarbonate as HCO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate as CO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L			2	0	<1	1	1.0	1	1	1	0
Fluoride	mg/L		4	2	2	0.2	0.2	0.2	0.2	0.2	0.2	0
Sulfate	mg/L			2	2	15.0	19.0	17.0	16.0	17.0	18.0	2.8
Hardness as CaCO3	mg/L			2	2	220	220	220	220	220	220	0
Calcium (DIS)	mg/L			2	2	50.0	52.0	51.0	50.5	51.0	51.5	1.4
Magnesium (DIS)	mg/L			2	2	22.0	23.0	22.5	22.3	22.5	22.8	0.7
Potassium (DIS)	mg/L			2	1	<1	1.0	1.0	1.0	1.0	1.0	0
Sodium (DIS)	mg/L			2	2	2.0	2.0	2.0	2.0	2.0	2.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		2	2	0.1	0.1	0.1	0.1	0.1	0.1	0.01
Kjeldahl Nitrogen as N	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Total Persulfate Nitrogen	mg/L			2	2	0.2	0.4	0.3	0.3	0.3	0.4	0.1
Phosphorus (TOT)	mg/L			2	2	0.01	0.03	0.02	0.01	0.02	0.02	0.01
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		2	0	<0.009	0.009	0.0090	0.0090	0.009	0.009	0
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			2	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			2	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			2	2	0.077	0.09	0.08	0.08	0.08	0.09	0.008
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			2	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			2	1	<0.00003	0.00004	0.00004	0.00003	0.00004	0.00004	0.000007
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			2	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			2	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			2	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		2	2	0.2	0.8	0.5	0.3	0.5	0.6	0.4
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			2	1	<0.0003	0.001	0.0007	0.0005	0.0007	0.0009	0.001
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			2	2	0.01	0.02	0.02	0.01	0.02	0.02	0.008
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			2	0	<0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			2	0	<0.002	0.002	0.0020	0.002	0.002	0.002	0
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			2	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			2	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			2	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.01
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			2	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			2	0	<0.008	0.008	0.008	0.008	0.008	0.008	0
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			2	2	0.003	0.008	0.006	0.004	0.006	0.007	0.004

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 10 Water Quality Summary Statistics, SW-11

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			19	19	0.2	0.9	0.5	0.4	0.5	0.6	0.2
Flow	Cubic Ft Sec			20	20	0.2	21.4	2.3	0.4	1.0	2.6	4.6
pH - Field	s.u.			27	27	7.5	8.7	8.2	8.1	8.2	8.4	0.3
Field Specific Conductivity	umhos/cm			27	27	312	497	402	384	404	425	44.2
Water Temperature	Deg C			27	27	-0.02	16.3	6.0	0.1	6.2	10.5	5.7
Dissolved Oxygen	mg/L	6.5		27	27	7.0	15.4	11.1	9.8	11.6	12.0	2.0
Physical Parameters												
Total Dissolved Solids	mg/L			27	27	166	282	229	215	231	240	25.8
Total Suspended Solids	mg/L			23	9	<4	68.0	13.7	4.0	10.0	11.5	15.2
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			27	27	160	250	204	195	210	220	21.2
Bicarbonate as HCO3	mg/L			6	6	210	260	238	225	245	250	19.4
Carbonate as CO3	mg/L			6	6	4.0	12.0	8.8	7.3	9.0	11.5	3.1
Chloride	mg/L			27	21	<1	2.0	1.3	1.0	1.0	1.6	0.4
Fluoride	mg/L		4	27	27	0.1	0.2	0.2	0.2	0.2	0.2	0.03
Sulfate	mg/L			27	27	9.0	46.0	20.1	14.0	18.0	23.5	8.0
Hardness as CaCO3	mg/L			27	27	156	267	217	194	225	236	28.7
Calcium (DIS)	mg/L			27	27	36.0	60.0	49.7	45.5	51.0	53.5	6.1
Magnesium (DIS)	mg/L			27	27	16.0	29.0	22.6	20.0	24.0	24.5	3.4
Potassium (DIS)	mg/L			27	26	<1	2.0	1.1	1.0	1.0	1.0	0.3
Sodium (DIS)	mg/L			27	27	2.0	3.0	2.6	2.0	3.0	3.0	0.5
Nutrients												
Nitrate + Nitrite as N	mg/L	10		27	24	<0.01	0.19	0.07	0.03	0.05	0.1	0.06
Kjeldahl Nitrogen as N	mg/L			4	1	<0.5	3.4	1.2	0.5	0.5	1.2	1.5
Total Persulfate Nitrogen	mg/L			12	12	0.09	0.5	0.2	0.1	0.2	0.3	0.1
Phosphorus (TOT)	mg/L			16	16	0.003	0.06	0.03	0.02	0.02	0.03	0.02
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		27	6	<0.009	1.4	0.09	0.009	0.009	0.03	0.3
Aluminum (TRC)	mg/L			6	6	0.08	0.3	0.2	0.1	0.2	0.3	0.1
Antimony (DIS)	mg/L		0.0056	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			26	0	<0.0005	0.005	0.001	0.0005	0.0005	0.002	0.001
Arsenic (DIS)	mg/L	0.15	0.01	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			26	2	<0.001	0.003	0.001	0.001	0.001	0.001	0.001
Barium (DIS)	mg/L		1	4	4	0.092	0.1	0.1	0.10	0.1	0.1	0.009
Barium (TRC)	mg/L			26	26	0.09	0.1	0.1	0.10	0.1	0.1	0.01
Beryllium (DIS)	mg/L		0.004	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			26	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00009
Cadmium (DIS)	mg/L	0.00025	0.005	4	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			26	3	<0.00003	0.00008	0.0000	0.00003	0.00003	0.000055	0.00002
Chromium (DIS)	mg/L		0.1	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			26	0	<0.001	0.01	0.007	0.002	0.01	0.01	0.004
Cobalt (DIS)	mg/L			4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			26	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			26	5	<0.001	0.003	0.0018	0.002	0.002	0.002	0.0005
Iron (DIS)	mg/L			4	3	<0.03	0.06	0.04	0.04	0.04	0.05	0.01
Iron (TRC)	mg/L	1		26	26	0.04	2.1	0.4	0.1	0.2	0.4	0.5
Lead (DIS)	mg/L	0.000545	0.015	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			26	8	<0.0003	0.0031	0.0006	0.0003	0.0003	0.0005	0.001
Manganese (DIS)	mg/L			4	1	<0.005	0.007	0.006	0.005	0.005	0.006	0.001
Manganese (TRC)	mg/L			26	16	<0.005	0.08	0.01	0.005	0.007	0.02	0.02
Mercury (DIS)	mg/L	0.00091	0.00005	4	0	<0.00001	0.00001	0.0000	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			26	4	<0.000005	0.00002	0.0000	0.000005	0.000005	0.00001	0.000003
Molybdenum (DIS)	mg/L			4	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			26	0	<0.001	0.005	0.003	0.002	0.002	0.004	0.001
Nickel (DIS)	mg/L	0.0161	0.1	4	0	<0.01	0.01	0.0100	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			26	3	<0.001	0.01	0.003	0.001	0.001	0.002	0.004
Selenium (DIS)	mg/L	0.005	0.05	4	0	<0.001	0.001	0.0010	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			26	4	<0.0002	0.001	0.0004	0.0002	0.0002	0.0009	0.0004
Silver (DIS)	mg/L		0.1	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			26	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	4	4	0.1	0.2	0.2	0.2	0.2	0.2	0.050
Strontium (TRC)	mg/L			26	26	0.1	0.2	0.2	0.2	0.2	0.2	0.025
Thallium (DIS)	mg/L		0.00024	4	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			26	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	4	4	0.0007	0.0009	0.0008	0.0007	0.0008	0.0008	0.0001
Uranium (TRC)	mg/L			26	9	<0.0007	0.008	0.0055	0.0009	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	4	0	<0.01	0.01	0.0100	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			26	14	<0.002	0.016	0.006	0.002	0.004	0.01	0.004

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 11 Water Quality Summary Statistics, SW-12

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			0	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			2	2	8.8	24.2	16.5	12.7	16.5	20.4	10.9
pH - Field	s.u.			2	2	7.8	7.8	7.8	7.8	7.8	7.8	0.04
Field Specific Conductivity	umhos/cm			2	2	75.0	97.0	86.0	80.5	86.0	91.5	15.6
Water Temperature	Deg C			2	2	10.8	14.1	12.5	11.6	12.5	13.3	2.3
Dissolved Oxygen	mg/L	6.5		2	2	8.7	9.2	9.0	8.8	9.0	9.1	0.4
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 12 Water Quality Summary Statistics, SW-13

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			0	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			2	2	33.1	77.7	55.4	44.2	55.4	66.5	31.6
pH - Field	s.u.			2	2	7.7	8.7	8.2	8.0	8.2	8.4	0.7
Field Specific Conductivity	umhos/cm			2	2	216	251	234	225	234	242	24.7
Water Temperature	Deg C			2	2	16.5	17.5	17.0	16.8	17.0	17.3	0.7
Dissolved Oxygen	mg/L	6.5		2	2	8.6	8.9	8.8	8.7	8.8	8.8	0.2
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 13 Water Quality Summary Statistics, SW-14

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			16	16	0.3	0.9	0.5	0.4	0.4	0.5	0.1
Flow	Cubic Ft Sec			19	19	0.3	11.8	2.7	0.7	1.5	3.0	3.2
pH - Field	s.u.			19	19	6.1	8.4	7.9	7.7	8.1	8.2	0.5
Field Specific Conductivity	umhos/cm			20	20	263	439	368	347	376	407	50.5
Water Temperature	Deg C			20	20	-0.9	13.7	6.9	3.1	7.1	11.5	4.6
Dissolved Oxygen	mg/L	6.5		20	20	7.6	15.0	10.9	9.8	10.3	11.8	1.8
Physical Parameters												
Total Dissolved Solids	mg/L			21	21	175	244	221	214	228	233	18.5
Total Suspended Solids	mg/L			21	3	<4	15.0	5.0	4.0	4.0	4.0	2.8
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			21	21	160	220	203	190	210	220	21.3
Bicarbonate as HCO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate as CO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L			21	21	1.0	2.5	1.9	1.8	2.0	2.0	0.3
Fluoride	mg/L		4	21	21	0.1	0.2	0.2	0.2	0.2	0.2	0.04
Sulfate	mg/L			21	21	6.5	19.0	9.2	7.0	8.1	9.3	3.2
Hardness as CaCO3	mg/L			21	21	153	232	209	198	213	225	22.0
Calcium (DIS)	mg/L			21	21	38.0	57.0	52.5	48.0	54.0	57.0	5.5
Magnesium (DIS)	mg/L			21	21	12.0	23.0	18.9	18.0	19.0	20.0	2.4
Potassium (DIS)	mg/L			21	19	<1	2.0	1.0	1.0	1.0	1.0	0.2
Sodium (DIS)	mg/L			21	21	2.0	3.0	2.6	2.0	3.0	3.0	0.5
Nutrients												
Nitrate + Nitrite as N	mg/L	10		21	20	<0.01	0.3	0.1	0.04	0.09	0.2	0.09
Kjeldahl Nitrogen as N	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Total Persulfate Nitrogen	mg/L			21	20	<0.003	1.3	0.3	0.1	0.2	0.3	0.3
Phosphorus (TOT)	mg/L			21	16	<0.003	0.2	0.02	0.004	0.008	0.01	0.04
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		21	3	<0.009	0.05	0.01	0.009	0.009	0.009	0.009
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			21	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			21	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			21	21	0.08	0.1	0.1	0.1	0.1	0.1	0.01
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			21	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			21	2	<0.00003	0.00004	0.00003	0.00003	0.00003	0.00003	0.000002
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			21	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			21	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			21	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		21	20	<0.02	0.4	0.1	0.02	0.05	0.12	0.1
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			21	1	<0.0003	0.0005	0.0003	0.0003	0.0003	0.0003	0.00004
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			21	2	<0.005	0.007	0.005	0.005	0.005	0.005	0.0005
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			21	0	<0.000005	0.00001	0.00001	0.00001	0.00001	0.00001	0
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			21	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			21	1	<0.001	0.002	0.001	0.001	0.001	0.001	0.0004
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			21	1	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00005
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			21	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			21	21	0.08	0.1	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			21	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			21	0	<0.008	0.008	0.008	0.008	0.008	0.008	0
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			21	1	<0.002	0.003	0.002	0.002	0.002	0.002	0.0002

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 14 Water Quality Summary Statistics, USGS-SC1

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			NA	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			37	37	9.3	152	45.5	13.8	28.0	67.5	38.4
pH - Field	s.u.			54	54	6.8	8.7	8.0	7.8	8.2	8.3	0.4
Field Specific Conductivity	umhos/cm			55	55	234	408	326	292	340	364	46.2
Water Temperature	Deg C			55	55	-1.0	13.1	4.4	0.2	3.5	9.0	4.3
Dissolved Oxygen	mg/L	6.5		55	55	7.1	16.6	11.2	10.1	10.8	12.2	1.7
Physical Parameters												
Total Dissolved Solids	mg/L			53	53	134	230	190	183	193	204	20.1
Total Suspended Solids	mg/L			53	13	<4	38.0	7.8	4.0	4.0	10.0	6.4
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			53	53	120	220	177	170	180	190	22.0
Bicarbonate as HCO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Carbonate as CO3	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L			53	53	1.0	5.0	1.7	1.0	1.5	2.0	0.929
Fluoride	mg/L		4	53	1	<0.1	0.1	0.10	0.1	0.1	0.1	0
Sulfate	mg/L			53	53	3.0	8.0	5.6	4.8	5.4	7.0	1.4
Hardness as CaCO3	mg/L			53	52	<7	214	175	167	183	191	31.7
Calcium (DIS)	mg/L			53	53	35.0	61.0	50.6	47.5	52.0	55.0	6.0
Magnesium (DIS)	mg/L			53	53	8.0	15.0	12.6	12.0	13.0	14.0	1.6
Potassium (DIS)	mg/L			53	53	1.0	1.0	1.0	1.0	1.0	1.0	0
Sodium (DIS)	mg/L			53	53	2.0	3.0	2.1	2.0	2.0	2.0	0.2
Nutrients												
Nitrate + Nitrite as N	mg/L	10		53	32	<0.01	0.1	0.04	0.01	0.02	0.08	0.04
Kjeldahl Nitrogen as N	mg/L			11	6	<0.5	5.0	1.9	0.5	2.2	3.0	1.6
Total Persulfate Nitrogen	mg/L			39	29	<0.003	1.1	0.1	0.04	0.07	0.2	0.2
Phosphorus (TOT)	mg/L			49	35	<0.003	0.05	0.01	0.004	0.009	0.01	0.009
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		53	17	<0.009	0.2	0.02	0.01	0.01	0.02	0.03
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			53	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			53	1	<0.001	0.001	0.0010	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			53	53	0.06	0.09	0.07	0.07	0.07	0.07	0.006
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			53	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			53	2	<0.00003	0.00009	0.00003	0.00003	0.00003	0.00003	0.000008
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			53	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			53	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			53	2	<0.002	0.003	0.0020	0.002	0.002	0.002	0.0001
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		53	53	0.07	1.7	0.3	0.1	0.1	0.3	0.3
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			53	6	<0.0003	0.001	0.0003	0.0003	0.0003	0.0003	0.0001
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			53	53	0.005	0.08	0.01	0.007	0.008	0.01	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			53	2	<0.000005	0.00001	0.000005	0.000005	0.000005	0.000005	0.0000007
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			53	0	<0.001	0.002	0.002	0.002	0.002	0.002	0.0003
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			53	6	<0.001	0.003	0.001	0.001	0.001	0.001	0.0004
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			53	0	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00004
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			53	1	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00003
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			53	53	0.1	0.2	0.1	0.1	0.1	0.1	0.009
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			53	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			53	4	<0.0003	0.008	0.007	0.008	0.008	0.008	0.002
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			53	15	<0.002	0.009	0.003	0.002	0.002	0.003	0.001

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

APPENDIX J

Scoping Report

Prepared for:

Montana Department of Environmental Quality

FINAL

Black Butte Copper Environmental Impact Statement Scoping Report

December 2017

ERM

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Acronyms and Abbreviations

CTF	Cement Tailings Facility
DEQ	Montana Department of Environmental Quality
EIS	Environmental Impact Statement
MCA	Montana Code Annotated
MEPA	Montana Environmental Policy Act
MT	Montana
Project	Black Butte Copper Project
Tintina	Tintina Montana Inc.

1. INTRODUCTION

The Montana Department of Environmental Quality (DEQ) is preparing an Environmental Impact Statement (EIS) for the operating permit for the proposed Black Butte Copper Project (the Project), submitted by Tintina Montana Inc. (Tintina), a wholly owned subsidiary of Tintina Resources Inc. The EIS must comply with the requirements of the Montana Environmental Policy Act (MEPA) (Title 75, Chapter 1, Parts 1-3, Montana Code Annotated [MCA]) and the administrative rules adopted under MEPA. The purpose of the EIS is to analyze the potential environmental impacts of the Project and reasonable alternatives to the Proposed Action, including a No Action Alternative as required by MEPA, so that DEQ can make an informed decision in regards to the permit-ability of the Project and permit conditions.

To inform the EIS analysis of, and potential alternatives to the Project, DEQ established a public comment scoping period from October 2, 2017, to November 16, 2017. During this time, DEQ received written and oral comments from the public. This report describes the public scoping process, including the public meetings, and summarizes substantive comments received during the scoping period. It also contains materials generated for the scoping process.

The Project site is located about 15 miles north of White Sulphur Springs in Meagher County, Montana (MT). The site has a history of mineral exploration activities since the 1800s. Tintina applied to DEQ for an operating permit for the Project on December 15, 2015, under the Metal Mine Reclamation Act, Section 82-4-301, et seq., MCA. Pursuant to Section 82-4-337, MCA, DEQ determined that Tintina's application was complete and compliant and, on September 18, 2017, issued Tintina a draft operating permit for the Project. The proposed mine permit boundary encompasses 1,887.7 acres of privately owned ranch land, which would include all proposed facilities and surface disturbances. The location of the Project is shown in Figure 1.

The proposed Project is an underground copper mine. Multiple surface facilities, haul roads, access roads, and stockpiles would be constructed in addition to the underground mine portal. Ore mined from underground would undergo crushing and grinding onsite. Copper concentrate would be separated from a tailings waste stream via a flotation process. The tailings would be managed onsite by storing a portion underground as cemented backfill and storing the rest as cemented paste tailings in a tailings storage facility on the surface. The copper concentrate would be transported offsite for further processing.

Reclamation conducted contemporaneous to construction would stabilize disturbed areas throughout the life of mine. Monitoring programs would continue during construction, operations, temporary closure, and in permanent closure until closure objectives are met. Upon final closure, surfaces would be revegetated with pre-mining seed mixes adapted to the area.

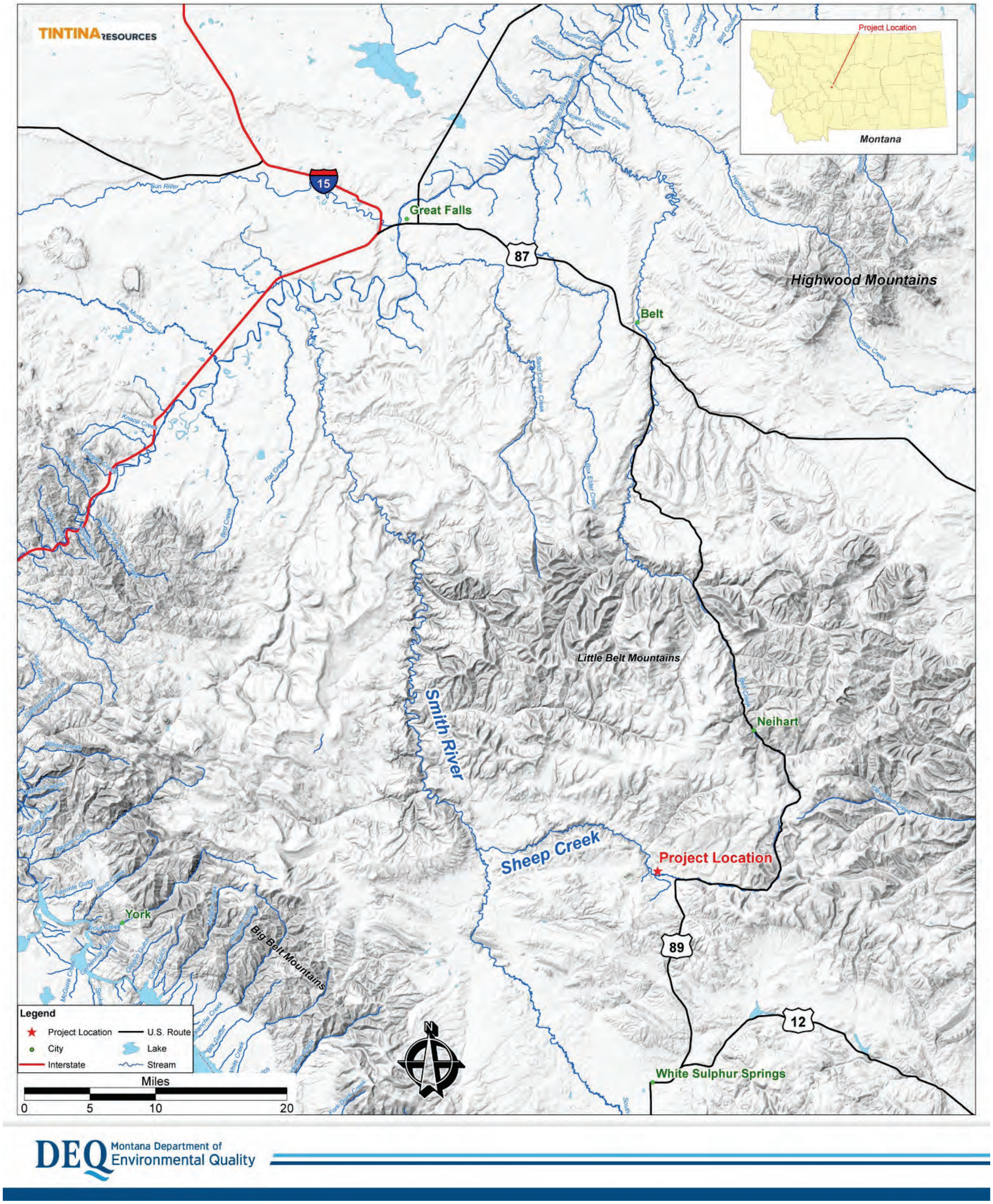

Figure 1: Project Location

2. SCOPING PROCESS

The purpose of scoping is to provide information about Tintina's proposed Project to the public, to identify issues related to the proposed Project that are likely to involve significant impacts that will be analyzed in depth in the EIS, and to identify possible alternatives to be considered. Knowing the scope and the importance of issues assists the DEQ in preparing an accurate and timely environmental analysis. The scoping process also helps identify issues important to the community and is designed to encourage public input.

Comments received during the scoping phase are combined with review of the Project by an interdisciplinary team of technical experts to establish the scope of analysis to be conducted in the EIS. Alternatives will be developed based on issues of concern raised by the public, participating government agencies, and EIS team resource specialists. Following scoping, a Draft EIS will be published and made available for public review and comment.

Public scoping comments were received from October 2, 2017, to November 16, 2017. Comment letters were submitted by email (deqtintinablackbuttecopperproject@mt.gov), by mail (Craig Jones, DEQ, P.O. Box 200901, Helena, MT 59620-0901), and provided orally during four public meetings. DEQ reviewed, coded, and organized all public comments into a database. Substantive comments on EIS scoping (those pertaining to the analysis) are summarized in Section 4 below.

A total of 9,236 comment letters were received, which include transcripts from stenographers at the public meetings (see Table 1). Two versions of an automatically generated form letter were received. Comments from these letters were repeated 8,928 times and made up 97 percent of all comment letters received. A small fraction of individuals chose to edit or create a variant of the form letters by adding customized text. The comments in the form letters focused on the Smith River. There were 308 individuals who provided unique comment letters.

Table 1: Scoping Comment Count Summary

Comment Type	Number of Commenters	Number of Comments
Unique (emails, letters, comment forms)	206	1,134
Unique Transcripts (from meeting court reporter)		
Great Falls	31	84
White Sulphur Springs	16	37
Helena	36	85
Livingston	19	65
Form Letter 1		
Variants	119	137
Non-Variants	5,400	N/A
Form Letter 2		
Variants	93	114
Non-Variants	3,316	N/A
Total	9,236	1,656

3. PUBLIC SCOPING MEETINGS

3.1. Notification Process

On August 15, 2017, the DEQ issued a press release on the MONTANA.GOV website (http://deq.mt.gov/Public/PressRelease/mine-application-deemed-complete-and-environmental-review-to-begin) stating that the mine application was complete and the environmental review was set to begin. The DEQ issued a second release on September 18, 2017, (http://deq.mt.gov/Public/PressRelease/deq-begins-review-of-black-butte-copper-project-under-the-montana-environmental-policy-act) indicating the review had begun under MEPA. On October 3, 2017, the DEQ issued a press release (http://deq.mt.gov/Public/PressRelease/scoping-meetings-held-for-environmental-impact-statement-of-proposed-mine) disclosing the times and locations of three public meetings as well as information about the EIS and permit application. A fourth press release was issued for adding a fourth and final meeting on October 24, 2017, (http://news.mt.gov/additional-scoping-meeting-announced-for-environmental-impact-statement-of-proposed-mine) containing similar information. Each of these releases was also submitted via email to national, state, and local news outlets on the respective release dates (see Appendix A).

The DEQ prepared a legal notice for the public scoping meetings. In addition to providing information about the public meetings, the notice described the purpose of the scoping meetings, provided a web link to access the permit application, and identified methods to submit EIS scoping comments. The notice was published in the following newspapers:

- Livingston Enterprise, a daily newspaper, on October 6, 13, and 20 of 2017;
- Great Falls Tribune, a daily newspaper, on October 8, 15, and 22 of 2017; and the
- Meagher County News for three weeks beginning October 5 and ending October 19, 2017.

On September 29, 2017, public meeting notices were mailed to 151 organization or individuals. On October 2, 2017, the DEQ emailed 85 notices. Those contacted had previously expressed interest in the Project.

3.2. Public Scoping Meetings

On October 30, 2017, a public meeting was held at the Civic Center in Great Falls, MT. On November 1, 2017, a second meeting was held at the White Sulphur Springs High School gymnasium in White Sulphur Springs, MT. The third meeting was held at the Radisson Hotel in Helena, MT, on November 6, 2017. The final public meeting was held November 7, 2017, in Livingston, MT, at the Park County High School Gymnasium. Each meeting began at 6 pm and ended at 9 pm. The public registered to enter the meeting, were offered materials, and signed up to speak if they desired.

Each public meeting began with an open house. Its purpose was to allow the public to speak with technical experts about the Project. Posters were prepared on the following topics and DEQ staff was available to speak to these topics as well as others:

1. MEPA and Metal Mining Reclamation Act Process

2. How to Submit Comments
3. EIS Potential Schedule
4. Issues to be Examined in the EIS
5. Site Location and Plan
6. Cement Tailings Facility (CTF)
7. Hydrology
8. Geochemistry
9. Water Treatment

Following the open house, DEQ gave a brief presentation about the EIS scoping process and the Project. Finally, the public was invited to speak to DEQ staff. Speakers were chosen at random and their words were recorded by a stenographer. A summary of registered attendance is captured in Table 2.

Table 2: Summary of Public Meeting Attendance

Location	Number of Registered Attendees
Great Falls	130
White Sulphur Springs	70
Helena	161
Livingston	99
Total	460

4. MAJOR COMMENTS RAISED DURING SCOPING

Every comment letter was reviewed by the DEQ or its third-party contractor, Environmental Resources Management (ERM). Tables 3 and 4 provide summaries of comments received during the scoping process. Each comment was coded based upon the resource topic it addressed (e.g. water, wildlife, economics). The text does not capture any comment verbatim and does not attempt to report the most often submitted comments. Table 3 identifies the most salient or substantive comments in regards to the EIS analysis, potential mitigation, and consideration of alternatives.

Table 3: Summary of Major Comments

Resource Topic	Comment Summary
Air Quality	The EIS should evaluate the Project's potential effect on climate change and how this effect would impact natural resources. Fugitive dust and its impacts to natural resources should be evaluated.
Alternatives	The DEQ should not analyze alternatives that they have the legal authority to implement. The scope of alternatives analysis should be done in consultation with Tintina Resources in accordance with the MMRA and MEPA requirements. The EIS should consider a no action alternative. The EIS should provide an alternative analysis informed by other tailings impoundment that reduces the risk of environment impacts including liner degradation, impoundment location and design. The EIS should evaluate sourcing metals from another ore body. The EIS should evaluate the use of tanks instead of ponds to retain process water. The EIS should evaluate alternative truck transportation routes. The EIS should evaluate a wetland treatment system for a long a long-term water treatment solution.
Aquatic Species	The EIS should collect fisheries baseline data for several years that includes Calf Creek, Sheep Creek, the South Fork of Sheep Creek, Coon Creek, Moose Creek, the Smith River, and Missouri River. This analysis and subsequent impact analysis should consider climate change, species composition, size distribution, spawning, fish densities, seasonal migration behavior, macroinvertebrates, amphibians, mollusks, waterway physical characteristics, metal concentrations in fish tissue, and effects from changes to water temperature, flow and quality. Sources of water to streams and rivers via groundwater and surface water including wetlands should be evaluated for potential impacts. Potential for acid mine drainage to develop and affect fisheries should be evaluated.
Cultural Resources	The EIS should evaluate the effects of archaeological features of the Smith River. The EIS should evaluate cultural and archaeological resources and cultural landscapes that could be affected by the Project including those near the Project site.
Cumulative Effects	Induced effects from mine development such as road and building construction should be evaluated in combination with the Project. The EIS should evaluate current water withdrawals from Sheep Creek and Smith River in combination with the potential effects of the Project. The EIS should evaluate the possible contributions of Superfund sites in the area of Great Falls in combination with the Project's potential effects on the Missouri. The EIS should evaluate the combined effect of the Project potentially contaminating the already contaminated Livingston rail. The EIS should consider the combined effects of truck traffic from new industrial activity along the Missouri River Corridor and truck traffic from the Project. Fugitive dust from train cars should be considered in combination with effects from the Project. Other companies may mine the area in the future. A mining district of multiple Projects should be evaluated. Cumulative effects to fisheries should be evaluated.

Resource Topic	Comment Summary
Financial Assurance	The EIS should disclose reclamation bonding costs and calculations of the reclamation and closure bond to demonstrate sufficient funds will be in place, including paying for long-term water treatment if needed. The EIS should also disclose the form(s) of financial assurance that will be required. The EIS should look at the effects on individuals' taxes resulting from inadequate bonding.
General Topics	The EIS should evaluate the effects and response to unforeseen events. The EIS should evaluate the probability of the Smith River being degraded and the indirect effects from that degradation. A Failure Modes Effects Analysis should be completed for the CTF. The EIS should analyze the potential impacts from CTF liner failure.
Geotechnical Stability	The effects of earthquakes and heavy rains on the mine should be studied in relation to geotechnical stability. The evaluation and certification of cement tailings facility stability should be disclosed in the EIS. A Failure Modes Effects Analysis should be completed.
Human Health and Safety	The EIS should evaluate significant environmental, health and safety impacts for Meagher County and for neighboring counties and communities as a result of the need to transport concentrated copper ore from the mine. The EIS should go beyond air and water standards and evaluate complex physical and mental health benefits of an outdoor recreation based economy. The EIS should evaluate the effects to ranchers and property owners who source their drinking water from the Smith River and who may breathe air emissions from the mine.
Land Use, Recreation, and Visual Resources	Property boundaries need to be checked to ensure mining activities do no encroach on public lands. The EIS should evaluate mitigation to maintain the scenery along Kings Hill Scenic Byway. Catastrophic spills from trucks on Rt. 89 should be evaluated. Potential transportation impacts require greater scrutiny. The Smith River must be carefully evaluated and specifically addressed. The EIS should evaluate the impacts to the recreation and agricultural industry.
MEPA Adequacy	The EIS timeline is not long enough to properly evaluate the Project. The scope of analyses needed cannot be accomplished in the allotted time. MEPA requires the evaluation of potential direct, indirect and cumulative effects. The MEPA process was started prematurely because the application is incomplete and without the involvement of federal agencies. An application cannot be considered complete until the proposer owns or controls all of the minerals it intends to mine it its application. In light of constitutional rights to clean and healthful environment, the EIS must explain how negative impacts of the Project on the biological, physical, social, economic, cultural, and aesthetic environment could maintain and improve the environment in the Smith River drainage. To meet the requirements of the state law, information in the EIS must be thorough and accurate and its analysis must be probing and critical.

Resource Topic	Comment Summary
Noise and Vibration	Noise impacts on people and wildlife in the vicinity of the Smith River should be evaluated. The EIS needs to evaluate noise impacts from the Little Moose Subdivision located 3 miles from the proposed mill. This was left out of noise assessments.
Project Description	The EIS should evaluate the effects of mining the entire ore body within the federal mining claims and assume open-pit mining techniques are used. The Lowry deposit is a part of the mine plan and should be included as a part of the Project. The intentions of Tintina in their financial statements should be used to define the Project, not the permit application. The EIS should evaluate the potential for mine expansion. The EIS should evaluate the expected life of the cement tailings facility liners and the degradation rates of cement and binding materials. The EIS should disclose safeguards to protect creeks and rivers and engineered redundancies for environmental protection. The EIS should disclose if the proposer intends to mine under Sheep Creek.
Permitting and Regulatory Considerations	The EIS must address how this mine will guarantee a clean and healthy environment consistent with the Montana Constitution. The permit application is incomplete because it does not consider the possible expansion of the mine. The EIS should disclose and evaluate the state mineral lease. There is potentially a need for a utility corridor across federal lands as part of this Project. Any development of this nature would require the issuance of a Special Use permit and environmental analysis and decision.
Socioeconomics	Population and urban growth and demographics in White Sulphur Springs as a result of mining should be studied. The DEQ must perform an economic impact assessment to determine the direct and indirect values provided by recreation on the Smith River. The EIS should evaluate cultural and intrinsic values that the Smith River provides. The EIS should evaluate the economic loss if the Smith River is impacted. The EIS should evaluate the impact on rural life by the introduction of the mine. The EIS should evaluate the effects of a boom and bust mining cycle on White Sulphur Springs including the costs of building infrastructure that would only be needed temporarily such as schools. The EIS should evaluate how many jobs will be provided to local residents. Environmental justice must be included in the EIS. Consider the loss of state tax dollars if the Smith River is impacted. The EIS should include a detailed economic analysis of Meagher County.
Vegetation	The EIS should evaluate the spread of weeds on lands adjacent to the Project site and adopt mitigation.

Resource Topic	Comment Summary
Water Resources	The EIS should perform a rigorous review of potential long-term impacts to the Smith River and its watershed. The EIS needs to address the dynamic aquifer and springs. The EIS should evaluate downstream users of water for irrigation, drinking, fisheries and recreation. The Forest Service administers livestock allotments on the federal and private lands of Black Butte Section 26 and on the federal lands of the Moose Creek allotment in Section 18 to the north of the proposed Project. The EIS should evaluate federal water rights for livestock and wildlife. The EIS should evaluate the durability and longevity of proposed water treatment as well as contingencies. The EIS should evaluate surface and groundwater quantity and quality and the potential for acid mine drainage. The EIS should evaluate algae blooms in the Smith River.
Wetlands	The EIS should examine the impact of filled wetlands on cold-water storage during low water periods on Sheep Creek and the effects on the Smith River.
Terrestrial Wildlife	The EIS should evaluate how mining activities in conjunction with climate change, would affect the water table and floodplains of the Smith River and how that will affect long-term population persistence of wildlife that use riparian systems. The EIS should disclose the specifics of the wildlife baseline data collection efforts and discuss how the methodology effects observations. More recent mapping and avian data should be used because this information is too old to be reliable. The protocol for wildlife observations and use of direct evidence is not adequate for some species such as Canada lynx and wolverine. There was no effort made to inventory bats. Small mammals, raptor, amphibians, reptiles analyses is incomplete or their survey methodologies poorly explained. The EIS effects analysis should evaluate potential impacts to wildlife including migration patterns due to traffic, dust, noise, and increased human populations. The wildlife report is lacking several species known to be in the area such as Grizzly bear, lynx, wolverine, bald eagles, and peregrine falcons. The study area is too small and does not consider haul roads. The duration of wildlife monitoring is too short to sufficiently observe species.

Table 4: Scoping Comment Issue Summary

Comment Issue	Number of Unique Comments	Number of Form Letter Comments
Air Quality	9	1
Alternatives	11	0
Aquatic Species	67	0
Cultural Resources	5	0
Cumulative Effects	37	1
Financial Assurance	62	3
General Topics	361	1
Geotechnical Stability	13	0
Hazardous Materials	10	0
Human Health and Safety	14	0
Land Use, Recreation, and Visual Resources	74	1
MEPA Adequacy	40	1
Noise and Vibration	3	0
Project Description	59	0
Permitting and Regulatory Considerations	18	0
Socioeconomics	214	3
Vegetation	3	0
Water Resources	375	8
Wetlands	1	0
Terrestrial Wildlife	32	0

APPENDIX A

Press Releases for Public Scoping Meetings

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Text/HTML

Meeting Agenda (http://deq.mt.gov/Portals/112/Land/FedSuperFund/Documents/Draft Agenda_Advisory9_12_17.docx?ver=2017-09-15-102511-103)

DEQ Press Releases

Ponozzo, Kristi (http://deq.mt.gov/Public/PressRelease/author/ponozzo-kristi) / Tuesday, October 3, 2017 / Categories: Department of Environmental Quality (http://deq.mt.gov/Public/PressRelease/category/department-of-environmental-quality)

Scoping meetings held for Environmental Impact Statement of proposed mine

DEQ asking for public comment to identify issues likely to involve significant impacts and possible alternatives

HELENA – The Montana Department of Environmental Quality is in the process of preparing an Environmental Impact Statement under the Montana Environmental Policy Act for the Black Butte Copper Project proposed by Tintina Montana.

The EIS will analyze the potential impacts of the proposed underground mine and serve as the MEPA review for other potential permits that may be issued by DEQ, including an air quality permit, a public water supply permit and a surface water discharge permit. It also lays out how the mining operation proposed in Tintina's application complies with the Metal Mine Reclamation Act.

"This environmental review will be extensive and we take it very seriously," said Director Tom Livers. "It will be a complex EIS and public input is an important piece of the process."

The first phase in preparing an EIS is to determine the scope. DEQ is asking for comments from federal, tribal, state and local governments and interested persons and groups that help identify issues likely to involve significant impacts and possible alternatives to be considered in the EIS.

The scoping period will begin October 2, 2017, and end Thursday, November 16, 2017. The public scoping meetings will be held at the following locations, dates and times:

- Great Falls Civic Center, 2 Park Drive South, Great Falls, Montana, on Monday, October 30th from 6:00 to 9:00 pm
- White Sulphur Springs High School Gymnasium, 405 South Central Avenue, White Sulphur Springs, Montana, on Wednesday, November 1st from 6:00 to 9:00 pm.
- Park County High School Gymnasium, 102 View Vista Drive, Livingston, Montana, on Tuesday, November 7th from 6:00 to 9:00 pm

Under current law, DEQ has one year from the issuance of the more detailed compliance document to complete an Environmental Impact Statement. DEQ has hired a contractor to assist in the preparation of the EIS.

Tintina Montana originally submitted its application for a mining permit in December 2015. DEQ responded to the application in March 2016, outlining the need for complete information on geochemical aspects and hydrology. Tintina provided follow-up information in September 2016 and

DEQ issued a second deficiency response letter in December 2016. Tintina responded this May and DEQ issued a third deficiency letter with a response from Tintina in July. These responses provided DEQ complete information related to their geochemical testing and hydrologic modeling.

The permit application is available for the public to view at DEQ's main office in Helena (1520 East 6th Avenue). The application may also be viewed by visiting DEQ's website (http://deq.mt.gov/Land/hardrock/tintinamines (http://deq.mt.gov/Land/hardrock/tintinamines)).

Scoping comments may be submitted at one of the public meetings, electronically (deqtintinablackbuttecopperproject@mt.gov (mailto:deqtintinablackbuttecopperproject@mt.gov)), or by postal mail to the following address:

Craig Jones
Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

Questions on the environmental review may also be directed to Craig. Jones electronically (crajones@mt.gov (mailto:crajones@mt.gov)) or 406-444-0514. Comments must be submitted to DEQ no later than November 16, 2017.

DEQ will not accept comments that are threatening, defamatory, libelous, slanderous, or discriminatory in nature. DEQ will make reasonable accommodations for those with disabilities who wish to participate in the meeting. If you require an accommodation, please contact Jeni Garcin at 406-444-6469 or jgarcin@mt.gov (mailto:jgarcin2@mt.gov).

For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov (mailto:kponozzo@mt.gov)

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About Us

The Montana Department of Environmental Quality is charged with protecting a clean and healthy environment as guaranteed to our citizens by our State Constitution. Our ultimate goal is to protect public health and to maintain Montana's high quality of life for current and future generations.

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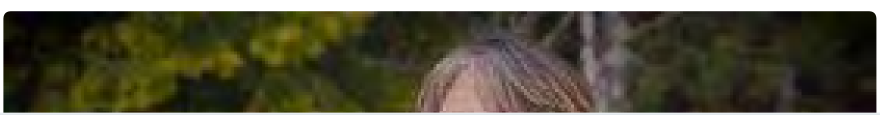

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Driscoll, Paul / Tuesday, October 24, 2017 / Categories: Department of Environmental Quality

Additional Scoping Meeting Announced for Environmental Impact Statement of Proposed Mine

HELENA – The Montana Department of Environmental Quality is adding an additional public scoping meeting in Helena for the process of preparing an Environmental Impact Statement under the Montana Environmental Policy Act for the Black Butte Copper Project proposed by Tintina Montana. The meeting will be held on Nov. 6 at the Radisson Colonial Hotel from 6 to 9 pm.

DEQ is making an additional public meeting option available in response to broad public interest in the project.

"We want to make as many opportunities available, as appropriate, so people can learn more about the project and provide us substantive feedback," said DEQ Director Tom Livers.

The EIS will analyze the potential impacts of the proposed underground mine and serve as the MEPA review for other potential permits that may be issued by DEQ, including an air quality permit, a public water supply permit and a surface water discharge permit. It also lays out how the mining operation proposed in Tintina's application complies with the Metal Mine Reclamation Act.

The first phase in preparing an EIS is to determine the scope. DEQ is asking for comments from federal, tribal, state and local governments and interested persons and groups that help identify issues likely to involve significant impacts and possible alternatives to be considered in the EIS.

The scoping period began October 2, 2017, and ends Thursday, November 16, 2017. The public scoping meetings will be held at the following locations, dates and times:

Great Falls Civic Center, 2 Park Drive South, Great Falls, Montana, on Monday, October 30th from 6:00 to 9:00 pm

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Park County High School Gymnasium, 102 View Vista Drive, Livingston, Montana, on Tuesday, November 7th from 6:00 to 9:00 pm

Under current law, DEQ has one year from the issuance of the more detailed compliance document to complete an Environmental Impact Statement. DEQ has hired a contractor to assist in the preparation of the EIS.

Tintina Montana originally submitted its application for a mining permit in December 2015. DEQ responded to the application in March 2016, outlining the need for complete information on geochemical aspects and hydrology. Tintina provided follow-up information in September 2016 and DEQ issued a second deficiency response letter in December 2016. Tintina responded this May and DEQ issued a third deficiency letter with a response from Tintina in July. These responses provided DEQ complete information related to their geochemical testing and hydrologic modeling.

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Department of Environmental Quality

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For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov

758

Cianne Martin

From: Ponozzo, Kristi <KPonozzo@mt.gov>
Sent: Monday, October 23, 2017 3:56 PM
Subject: News Release: Additional scoping meeting announced for Environmental Impact Statement of proposed mine

FOR IMMEDIATE RELEASE

October 23, 2017

Contact:
Kristi Ponozzo
Montana Department of Environmental Quality
Office: 406-444-2813

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For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov

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From: Ponozzo, Kristi
Sent: Monday, October 02, 2017 3:09 PM
Subject: News Release: Scoping meetings held for Environmental Impact Statement of proposed mine

FOR IMMEDIATE RELEASE

October 2, 2017

Contact:
Kristi Ponozzo
Montana Department of Environmental Quality
Office: 406-444-2813

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The permit application is available for the public to view at DEQ's main office in Helena (1520 East 6th Avenue). The application may also be viewed by visiting DEQ's website (http://deq.mt.gov/Land/hardrock/tintinamines).

Scoping comments may be submitted at one of the public meetings, electronically (deqtintinablackbuttecopperproject@mt.gov), or by postal mail to the following address:

Craig Jones
Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

Questions on the environmental review may also be directed to Craig. Jones electronically (crajones@mt.gov) or 406-444-0514. Comments must be submitted to DEQ no later than November 16, 2017.

DEQ will not accept comments that are threatening, defamatory, libelous, slanderous, or discriminatory in nature. DEQ will make reasonable accommodations for those with disabilities who wish to participate in the meeting. If you require an accommodation, please contact Jeni Garcin at 406-444-6469 or jgarcin@mt.gov.

For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov

###

From: Ponozzo, Kristi
Sent: Monday, September 18, 2017 3:53 PM
Subject: News Release: DEQ begins review of Black Butte Copper Project under the Montana Environmental Policy Act

FOR IMMEDIATE RELEASE

Sept. 18, 2017

Contact:
Kristi Ponozzo
Montana Department of Environmental Quality

Office: 406-444-2813

DEQ begins review of Black Butte Copper Project under the Montana Environmental Policy Act

HELENA – The Montana Department of Environmental Quality today announced that it will begin review of the Black Butte Copper Project under the Montana Environmental Policy Act.

Under current law, DEQ has one year from beginning the environmental review process to complete an Environmental Impact Statement. DEQ has been working on hiring a contractor who will assist in the preparation of the EIS and anticipates being able to start the EIS process this month.

The EIS is an extensive environmental review that discloses the potential impacts of the project and includes several opportunities for public review and involvement.

"Protecting clean air and water remains our top priority," said Montana Department of Environmental Quality Director, Tom Livers. "This is an extensive review process that ensures we continue to protect our environment, while following the law at every step."

Last month, DEQ notified Tintina Montana that its application was complete. Today DEQ is making available a detailed compliance document, with draft permit, that outlines the agency's determination that the mining operation proposed in Tintina's application complies with the Metal Mine Reclamation Act.

Tintina Montana will need to obtain several other permits from DEQ including air and water quality permits. Aspects of the project will also need to be reviewed and approved by the Hard Rock Mining Impact Board and the Department of Natural Resources and Conservation for any water rights related issues.

Tintina Montana originally submitted its application for a mining permit in December 2015. DEQ responded to the application in March 2016, outlining the need for complete information on geochemical aspects and hydrology. Tintina provided follow-up information in September 2016 and DEQ issued a second deficiency response letter in December 2016. Tintina responded this May and DEQ issued a third deficiency letter with a response from Tintina in July. These responses provided DEQ complete information related to their geochemical testing and hydrologic modeling.

The compliance document is posted to the DEQ's website at: http://deq.mt.gov/Land/hardrock/tintinamines

For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov

###

From: Ponozzo, Kristi
Sent: Tuesday, August 15, 2017 8:14 AM
Subject: News Release: Mine application deemed complete and environmental review to begin

FOR IMMEDIATE RELEASE

August 15, 2017

Contact:
Kristi Ponozzo
Montana Department of Environmental Quality
Office: 406-444-2813

Mine application deemed complete and environmental review to begin

DEQ completes deficiency reviews, determines application is compliant with Montana metal mines law

HELENA – The Montana Department of Environmental Quality has notified Tintina Montana that its latest permit application for the Black Butte Copper Project is complete and compliant. This determination means that DEQ has reviewed the metal mines application and, as required by law, has determined the revised permit application complies with the Montana Metal Mine Reclamation Act.

DEQ is now working on a more detailed compliance document and a draft permit, expected to be completed early next month. The compliance document will lay out how the mining operation proposed in Tintina's application complies with the Metal Mine Reclamation Act.

“This is a significant step in the process, but we still have many steps in our review of this application,” said Director Tom Livers. Livers explained that the department is working towards starting review of the application under the Montana Environmental Policy Act. Tintina Montana will need to obtain several other permits from DEQ including air and water quality permits. The project will also need to be reviewed and approved by the Hard Rock Mining Impact Board; the Department of Natural Resources and Conservation for any water rights related issues; and the Impoundment Review Panel and Engineer of Record.

Under current law, DEQ has one year from the issuance of the more detailed compliance document to complete an Environmental Impact Statement. DEQ has been working on hiring a contractor who will assist in the preparation of the EIS and anticipates being able to start the EIS process next month.

“Completing an EIS of this complexity will be challenging, so we are doing everything we can to move forward quickly to allow us as much time as possible,” said Livers.

The EIS is an extensive environmental review that discloses the potential impacts of the project and includes several opportunities for public review and involvement.

Tintina Montana originally submitted its application for a mining permit in December 2015. DEQ responded to the application in March 2016, outlining the need for complete information on geochemical aspects and hydrology. Tintina provided follow-up information in September 2016 and DEQ issued a second deficiency response letter in December 2016. Tintina responded this May and DEQ issued a third deficiency letter with a response from Tintina in July. These responses provided DEQ complete information related to their geochemical testing and hydrologic modeling.

The letter is posted to the DEQ’s website at: http://deq.mt.gov/Land/hardrock/tintinamines

For questions or to arrange an interview, please contact Kristi Ponozzo, Public Policy Director, Department of Environmental Quality, 406-444-2813 or by email at: kponozzo@mt.gov

###

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Updated October 10, 2017 JG

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Updated October 10, 2017 JG

APPENDIX B

Legal Notices for Public Scoping Meetings

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LEGAL NOTICE

The Montana Department of Environmental Quality (DEQ) will hold three public scoping meetings to receive comments from federal, tribal, state and local governments and interested persons and groups regarding the Black Butte Copper Project proposed by Tintina Montana (Tintina). The proposed underground mine would be located approximately 19 miles north of White Sulphur Springs in Meagher County in west-central Montana.

The public scoping meetings will be held at the following locations, dates and times:

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- White Sulphur Springs High School Gymnasium, 405 South Central Avenue, White Sulphur Springs, Montana, on Wednesday, November 1st from 6:00 to 9:00 pm.
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Craig Jones
Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

Questions on the environmental review may also be directed to Mr. Jones electronically (crajones@mt.gov) or (406)444-0514. **Comments must be submitted to DEQ no later than November 16, 2017.**

DEQ will not accept comments that are threatening, defamatory, libelous, slanderous, or discriminatory in nature. The DEQ will make reasonable accommodations for those with disabilities who wish to participate in the meeting. If you require an accommodation, please contact Jeni Garcin at 406-444-6469 or jgarcin@mt.gov.

Pub. Oct. 6, 13, 20, 2017

MNAXLP

AFFIDAVIT OF PUBLICATION

STATE OF MONTANA)
)ss.
COUNTY OF PARK)

Tracy Whitmire of lawful age, being first duly sworn, upon oath deposes and says: That she is, and at the several times herein mentioned was, The Principal Clerk of The Livingston Enterprise, a daily newspaper regularly printed, published and circulated daily, except on Saturday and Sunday in every week, at Livingston, Montana; and as such she has knowledge of all legal publication had in the said newspaper; and that she is a citizen of the United States of the State of Montana, of the age of twenty-one years and upwards, and not a party to, nor interested in the Regular board meeting.

That the forgoing Legal of which the annexed is a printed copy, was published in the said Livingston Enterprise, a daily newspaper as aforesaid, as follows, to-wit: the same was published in the regular and entire issues of said newspaper, and not in any supplement thereof on:

The 6th of October, A.D., 2017
The 13th of October, A.D., 2017
The 20th of October, A.D., 2017

and that hereto annexed and by reference expressly incorporated in, and made a part of, this affidavit at this point is a true, correct and exact clipping of the publication of the said Legal published in the newspaper aforesaid on the dates here-in before specified, and of the whole thereof.

Tracy L Whitmire

Subscribed and sworn to before me this 23rd day of October, 2017

Dina L. Rockafellow

Notary Public for the State of Montana,
Residing at Livingston, Montana.
My commission expires

DINA L ROCKAFELLOW
Notary Public
for the State of Montana
Residing at:
Livingston, Montana
My Commission Expires:
July 01, 2019

NOTARIAL SEAL STATE OF MONTANA

GREAT FALLS
TRIBUNE
PART OF THE USA TODAY NETWORK

AFFIDAVIT OF PUBLICATION
THE GREAT FALLS TRIBUNE
205 RIVER DR S
GREAT FALLS, MT 59405
Phone: (406) 791-1444
Toll Free (800) 438-6600

MT DEQ/ENVIRONMENTAL MGMT BUR
1520 E 6TH AVE
HELENA, MT 59601

REFERENCE: FAL-014302 **CASE NO:**
0002441705 Black Butte Copper Project

Elizabeth Jenkins being first duly sworn deposes and says that GREAT FALLS TRIBUNE COMPANY is a corporation duly incorporated under the laws of the State of Delaware, that the said GREAT FALLS TRIBUNE COMPANY is the printer and publisher of the GREAT FALLS TRIBUNE, a daily newspaper of general circulation of the County of Cascade, State of Montana, and that the deponent is the principal clerk of said GREAT FALLS TRIBUNE COMPANY, printer of the GREAT FALLS TRIBUNE, and that the advertisement here to annexed...

Legal Notice The Montana Department of Environmental Quality (DEQ) will hold three public scoping meetings to receive co

Has been correctly published 3 times in the regular and entire issue of said paper on the following dates:

10/08/17, 10/15/17, 10/22/17

[signature]

STATE OF MONTANA
County of Cascade

On this 23th day of October 2017, before me the undersigned, a Notary Public of the State of Montana, personally appeared

Elizabeth Jenkins

known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that she executed the same.

In witness whereof, I have hereunto set my hand and affixed my Notarial Seal of the day and year first above written.

Cheryl A Haynes
Print Name

Cheryl A Haynes
Signature

CHERYL A. HAYNES
NOTARY PUBLIC for the
State of Montana
Residing at Great Falls, Montana
My Commission Expires
January 17, 2019

Legal Notice

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(2441705) 10/8, 15, 22.

MNAXLP

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Scoping comments may be submitted at one of the public meetings, electronically (deqtintinablackbuttecopperproject@mt.gov), or by postal mail

AFFIDAVIT OF PUBLICATION

STATE OF MONTANA)
) ss.
County of Meagher)

Laura Phillips, being duly sworn, deposes and says: That she is Assistant Editor of the **MEAGHER COUNTY NEWS**, a newspaper of general circulation printed and published in White Sulphur Springs, Meagher County, Montana, and that the notice hereunto annexed: **Montana Department of Environmental Quality, Public Scoping Meetings - Tintina ,** has been correctly published in the regular and entire issue of every number of said paper for three weeks, beginning on the **5th** day of **October,** ending on the **19th** day of **October, 2017.**

Laura Phillips

Subscribed and sworn to before me this 20 Day of Oct, A. D. 2017

Heather Novark

Notary Public for the State of Montana

HEATHER NOVARK
NOTARY PUBLIC for the
State of Montana
Residing at White Sulphur Springs, Montana
My Commission Expires
August 01, 2020

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[signature]

Subscribed and sworn to before me this
20 Day of Oct, A. D. 2017

[signature]

Notary Public for the State of Montana

HEATHER NOVARK NOTARIAL SEAL STATE OF MONTANA
HEATHER NOVARK
NOTARY PUBLIC for the State of Montana
Residing at White Sulphur Springs, Montana
My Commission Expires
August 01, 2020

APPENDIX C

Public Meeting Sign-In Sheets

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Attendee Sign In Sheet

Black Butte Copper EIS Public Meeting
Great Falls Civic Center
October 30, 2017
6:00 - 9:00 PM

DEQ Montana Department of Environmental Quality

Attendees will be notified of publication of the Draft Environmental Impact Statement (EIS) and associated public comment period on the Draft EIS. This notification will be done by using either a postcard if address is given or an email if an email address is given.

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Attendee Sign In Sheet

Montana Department of Environmental Quality

Black Butte Copper EIS Public Meeting
Great Falls Civic Center
October 30, 2017
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Rick Heusel	3508 15th Ave So 59401	heusel.rick@gmail
Chuck + Joanne Heaton	157 Rain C Gt Falls MT 59404	
Paul Stephens	820 3rd Ave N #3	greateco@gmail.com
teresa shiner	1715 1st Ave N Great Falls MT	eggmomma@yahoo.com
Susan Colvin	287 McIver Rd, GT Falls, 59404	[illegible]
DANIEL BIEHL	4212 CLARK AVE G.F. 59405	dsbiehl@yahoo.com

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BOB BARTRAM	2626 — AVE S GF MT 59405	rabartram@msn.com
Kurt Wiggers	3208 2nd Ave S GF 59405	kwiggers@tractorandequipment.com
JAY VOSBERG	3408 FOX FARM RD	—
Debbie Burchak	2312 - 4th Ave S	—
MERRILL S. HAWLEY	314 S. Colo. Conrad MT. 59425	—
Scott Stafford	PO Box 1733, Great Falls MT 59403	—
Paul Wages	1076 Millegan Rd, Great Falls 59405	
DAVID J VANTIGEM	1312 3 AVE NORTH, GREAT FALLS 59401	DJVANTIGHEM@YAHOO.COM
Bruce Hooper	17 East Main St, White SS MT	
Trish McCoy	2718 Dawn Dr. Great Falls, MT 59404	pathfinders97@gmail.com

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Great Falls Civic Center
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Attendee Sign In Sheet

Black Butte Copper EIS Public Meeting
Great Falls Civic Center
October 30, 2017
6:00 - 9:00 PM

DEQ Montana Department of Environmental Quality

Attendees will be notified of publication of the Draft Environmental Impact Statement (EIS) and associated public comment period on the Draft EIS. This notification will be done by using either a postcard if address is given or an email if an email address is given.

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Black Butte Copper EIS Public Meeting
White Sulphur Springs High School
November 1, 2017
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Black Butte Copper EIS Public Meeting
White Sulphur Springs High School
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Attendee Sign In Sheet

Black Butte Copper EIS Public Meeting
Helena Radisson Hotel
November 6, 2017
6:00 - 9:00 PM

DEQ Montana Department of Environmental Quality

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Joseph (Alex) Sweeney	513 N. F St Livingston MT 59047	(612) 704-7301	alex[illegible]@gmail.com

APPENDIX D

Information Available at Scoping Meetings

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DEQ Montana Department of Environmental Quality

Black Butte Copper Project EIS

MEPA & EIS Description

The Montana Environmental Policy Act (MEPA) requires a state agency to prepare an environmental impact statement before taking any state action that will significantly impact the human environment. The MEPA process facilitates public participation in the environmental review. In the scoping stage of the MEPA process, the public is invited to assist the state agency in identifying potential environmental impacts and alternatives to the proposed action that should be considered in the EIS.

An EIS is prepared in two stages:

- DEQ prepares a Draft EIS that describes the environmental impacts of the proposed action and analyzes alternatives to the proposed action. In the Draft EIS, DEQ may identify a preferred alternative and give the reasons for the preference. DEQ then publishes the Draft EIS and solicits public comment on the Draft EIS.
- DEQ prepares and publishes the Final EIS. In the Final EIS, DEQ responds to the public comments received on the Draft EIS, evaluating the comments and indicating the information in the Final EIS that was changed in response to public comment. The Final EIS must also include DEQ's proposed decision with an explanation of the reasons for the proposed decision.

DEQ's actual decision is set forth in a Record of Decision that is published shortly after the Final EIS is published. While MEPA provides a procedural framework that a state agency must follow in making a decision, it does not provide any additional regulatory authority to the state agency beyond that contained in the state law under which the decision is being made. In the case of the proposed Black Butte Copper Project, DEQ's decision will be made under the Metal Mine Reclamation Act. MEPA does not give DEQ any regulator authority beyond that contained in the Metal Mine Reclamation Act.

DEQ Montana Department of Environmental Quality

Black Butte Copper Project EIS

Scoping Process under Montana Environmental Policy Act (MEPA)

The purpose of "scoping" is to provide information about Tintina's proposed project, to identify issues related to the proposed project that are likely to involve significant impacts that will be analyzed in depth in the EIS, and to identify possible alternatives to be considered. Knowing the scope and the importance of issues assists in an accurate and timely environmental analysis. The scoping process helps identify issues important to the community and is designed to encourage public input.

The results of the scoping phase are combined with review of the Project by an interdisciplinary team of technical experts to establish the scope of analysis to be conducted in the EIS. DEQ is asking your assistance in defining the issues and concerns you may have with regards to the proposed Project and to identify alternatives.

Alternatives will be developed based on issues of concern raised by the general public, participating government agencies, and EIS team resource specialists. The Draft EIS (DEIS) will be published and made available for public review.

If a commenter submits a substantive issue or an alternative during scoping, it only needs to be submitted. Substantive scoping comments that assist DEQ in the DEIS are ones that:

- Identify issues related to the Proposed Action that likely involve significant impacts and will be analyzed in depth in the EIS; or,
- Identify possible Alternatives to the proposed project, including possible mitigations, to be considered in the EIS.

Black Butte Copper Project EIS

Brief Description of Proposed Project

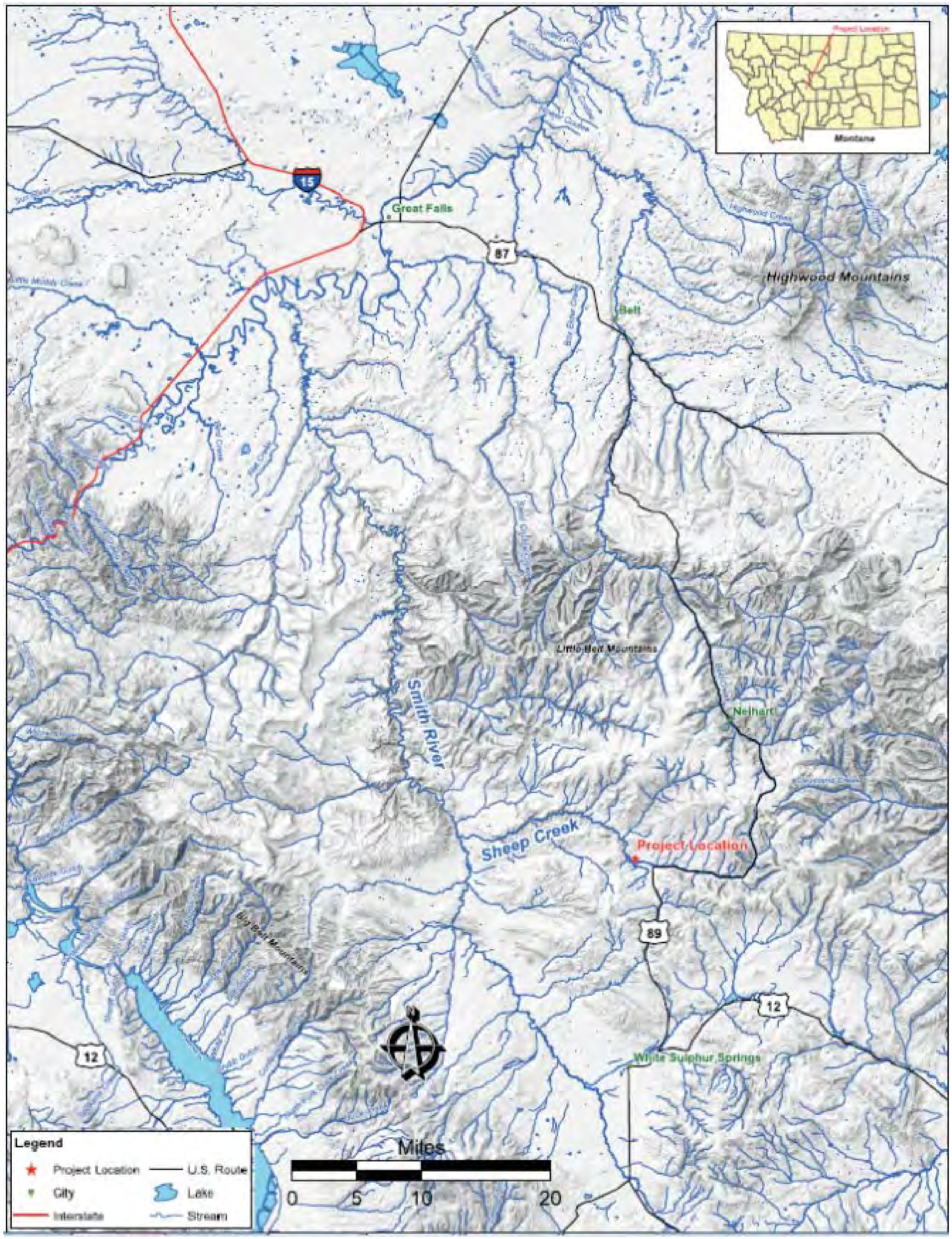
The Black Butte Copper Project (Project) site is located about 15 miles north of White Sulphur Springs in Meagher County, Montana. The site has a history of mineral exploration activities since the 1800s. Tintina applied to DEQ for an operating permit for the Black Butte Copper Project on December 15, 2015 under the Metal Mine Reclamation Act, Section 82-4-301, et seq., MCA. Pursuant to Section 82-4-337, MCA, DEQ determined that Tintina's application was complete and compliant and, on September 18, 2017, issued Tintina a draft operating permit for the Black Butte Copper Project. The proposed mine permit boundary encompasses 1,887.7 acres of privately-owned ranch land, which would include all proposed facilities and surface disturbances.

The proposed Project is an underground copper mine. Multiple surface facilities, haul roads, access roads, and stockpiles would be constructed in addition to the underground mine portal. Ore mined from underground would undergo crushing and grinding on-site. Copper concentrate would be separated from a tailings waste stream via a flotation process. The tailings would be managed on-site by storing a portion underground as cemented backfill and storing the rest as cemented paste tailings in a tailings storage facility on the surface. The copper concentrate would be transported off-site for further processing.

Reclamation conducted contemporaneous to construction would stabilize disturbed areas throughout the life of mine. Monitoring programs would continue during construction, operations, temporary closure, and in permanent closure until closure objectives are met. Upon final closure, surfaces would be revegetated with pre-mining seed mixes adapted to the area.

Black Butte Copper Project EIS

Project Map



DEQ Montana Department of Environmental Quality

Black Butte Copper Project EIS

Project Schedule

The Black Butte Copper Project EIS is currently in the Public Scoping phase (see Figure 1 below). After the Draft EIS (DEIS) is published, there will be another opportunity for the public to comment on the Project.

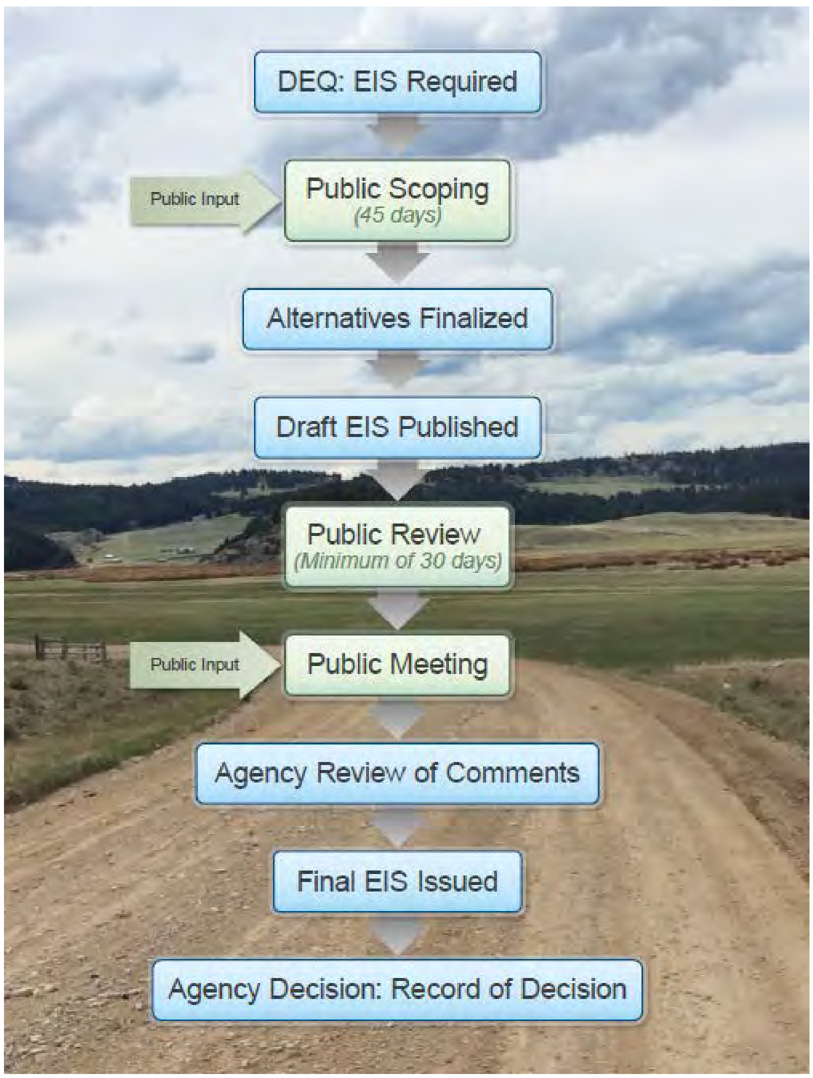


Figure 1: MEPA Process

DEQ Montana Department of Environmental Quality

Black Butte Copper Project EIS

How to Submit Comments to DEQ

Please provide your scoping comments using one of the following methods:

- Oral comments at one of the public meetings recorded by the court reporter
- Written comment form at one of the public meetings
- Email comments to: deqtintinablackbuttecopperproject@mt.gov
- Postal mail to the following address:

  Craig Jones

  Department of Environmental Quality

  P.O. Box 200901

  Helena, MT 59620-0901

Comments must be submitted to DEQ no later than November 16, 2017.

DEQ will not accept comments that are threatening, defamatory, libelous, slanderous, or discriminatory in nature.


MEPA Process
DEQ: EIS Required
Public Input
Public Scoping
(45 days)
Alternatives Finalized
Draft EIS Published
Public Review
(Minimum of 30 days)
Public Input
Public Meeting
Agency Review of Comments
Final EIS Issued
Agency Decision: Record of Decision

How to Submit Comments to DEQ

Scoping comments may be submitted:

- **Orally or in writing at one of the public meetings**
- **Via email**
  deqtintinablackbuttecopperproject@mt.gov
- **Postal Mail**
  Craig Jones
  Department of Environmental Quality
  P.O. Box 200901
  Helena, MT 59620-0901

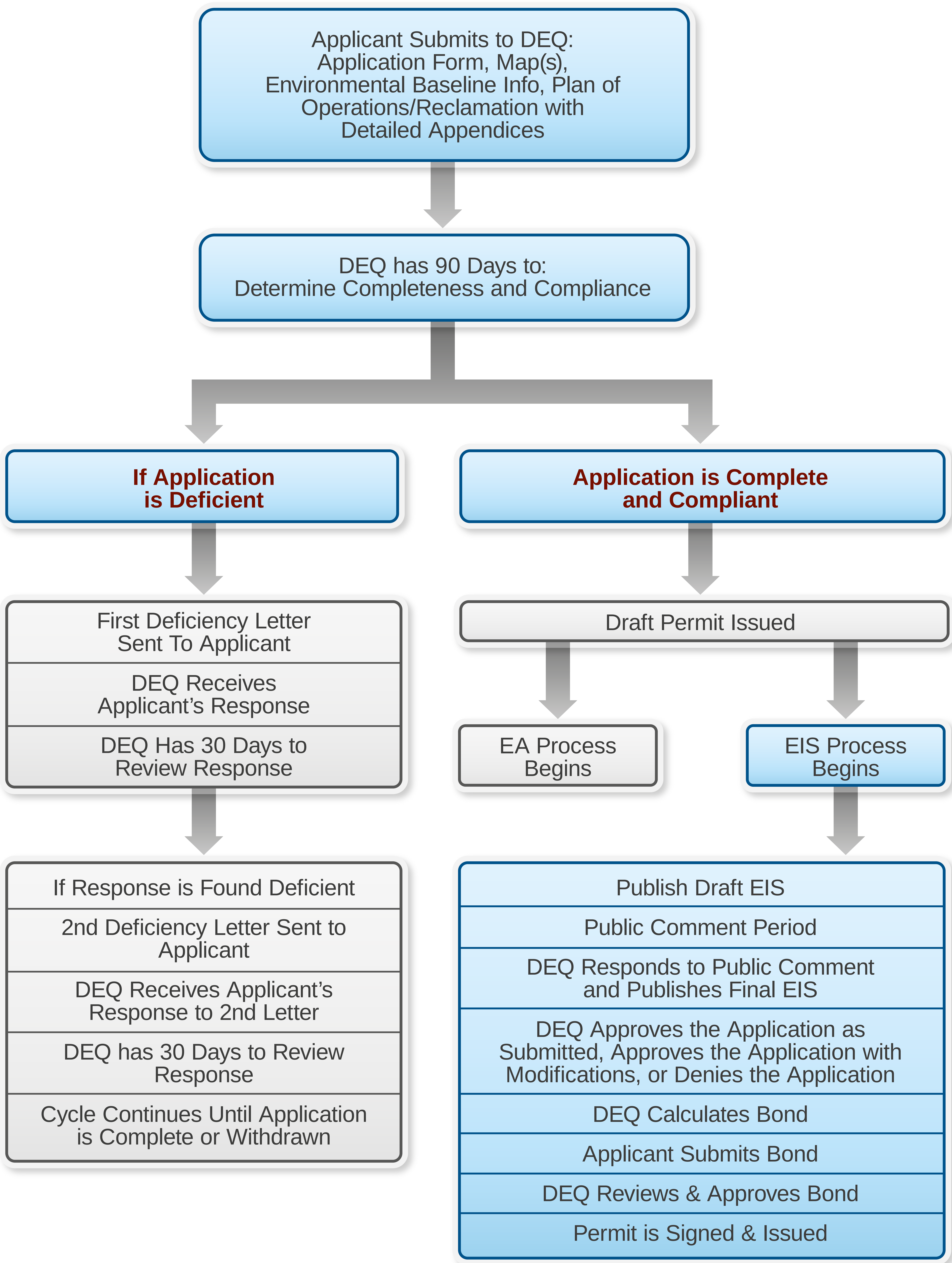
Comment Deadline is November 16th

Potential EIS Schedule

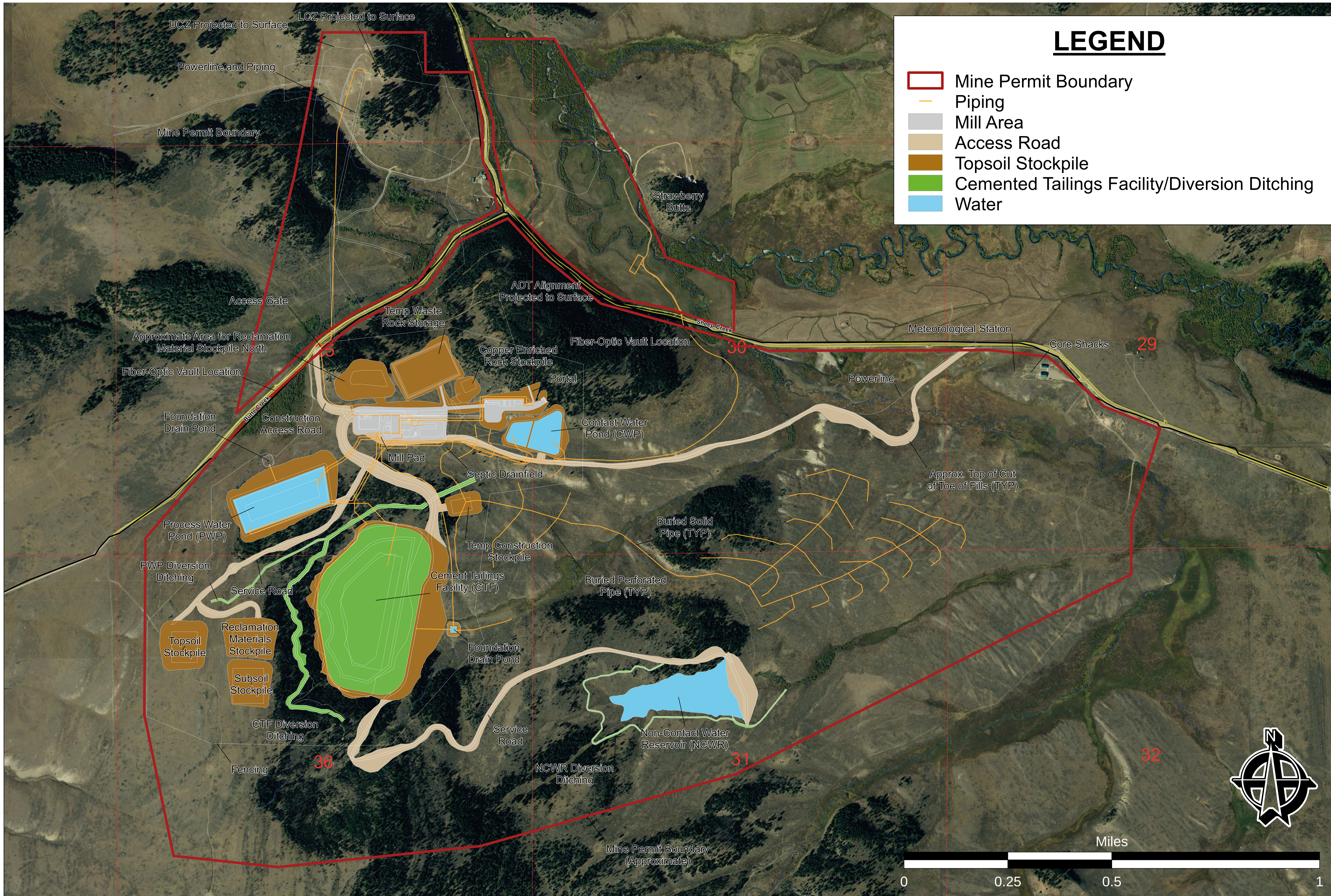
Issues to be Examined in EIS

Air Quality	Cultural Resources	Fisheries/ Aquatic Biology	Geochemistry
Geology	Geotechnical Engineering	Hazardous Materials	Hydrology
Land Use	Noise	Recreation	Socioeconomics
Soils	Transportation	Vegetation	Visuals
Water Quality/Quantity	Wetlands	Wildlife	

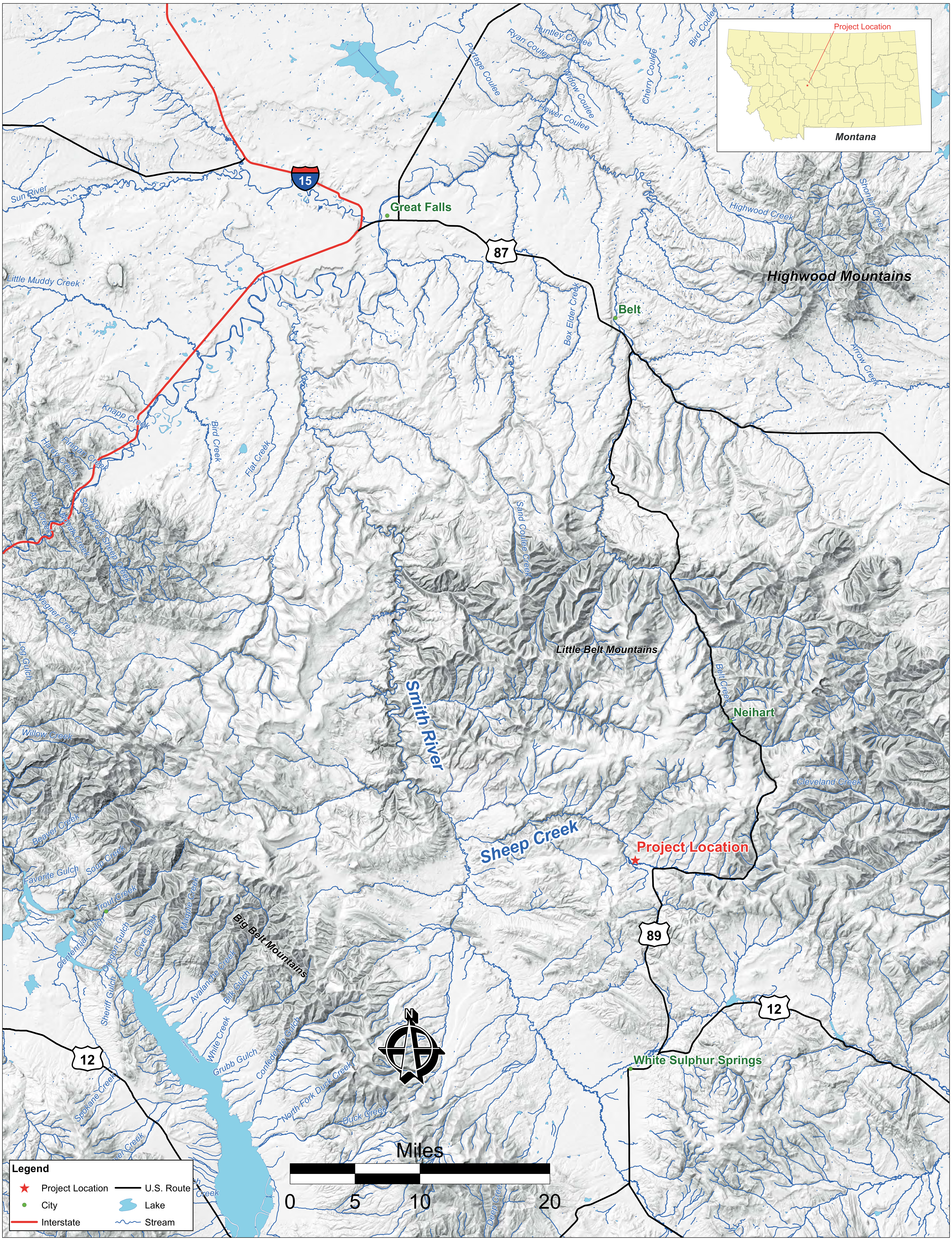
MMRA & MEPA Process



Facilities Site Plan



Project Location



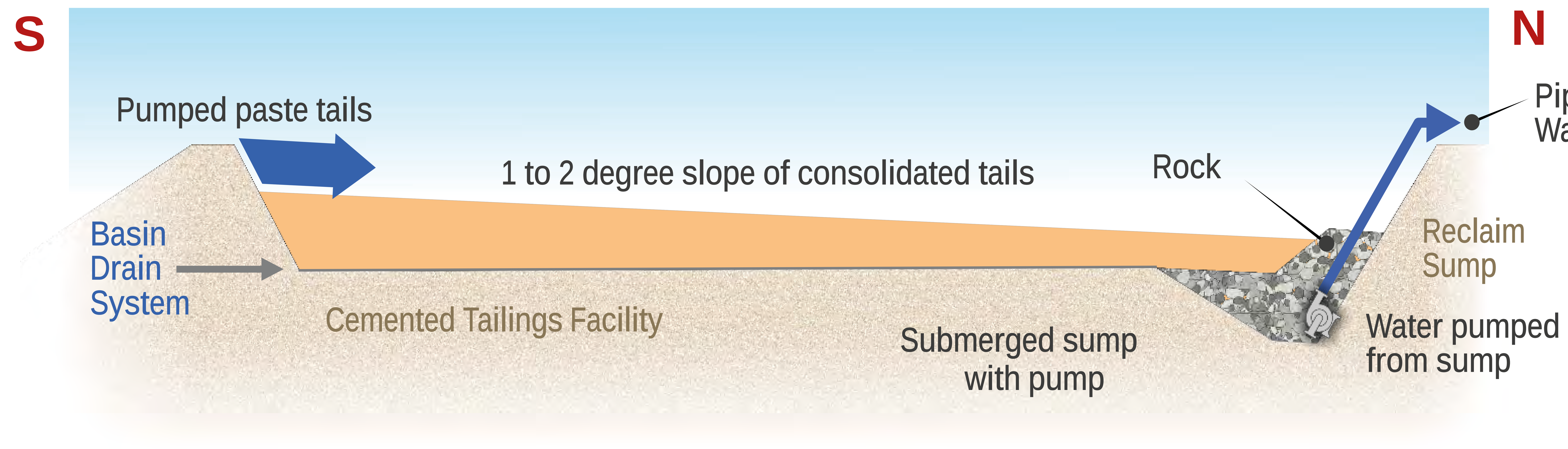
Oblique Aerial Simulation Looking Northwest

Black Butte Copper Project, Meagher County, Montana

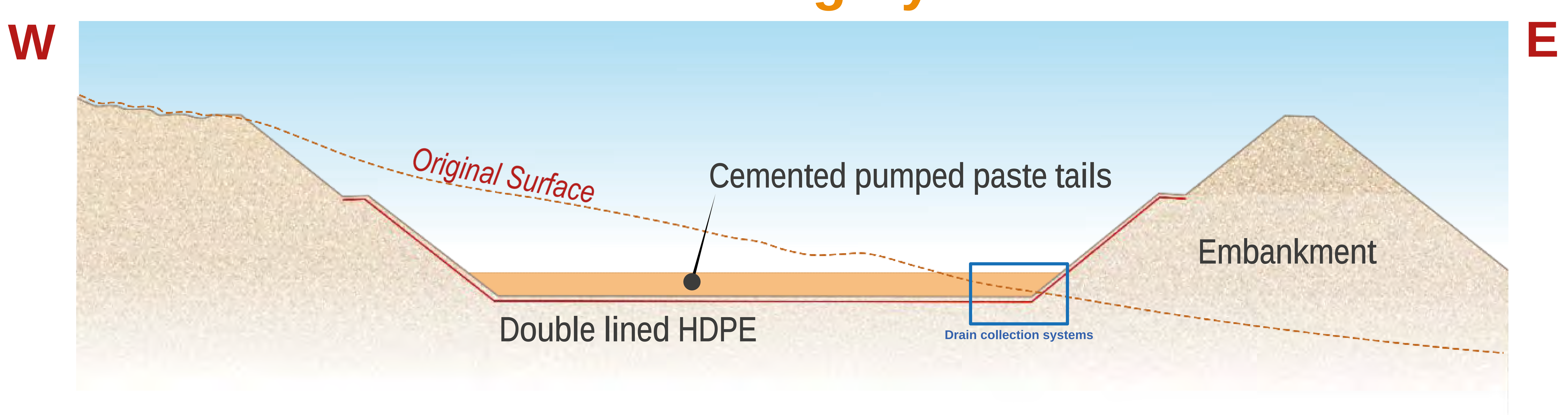
Source: Tetra Tech (2017).

Schematic Cemented Tailings Facility Sections with Lining System

Cemented Tailings Facility Long Section



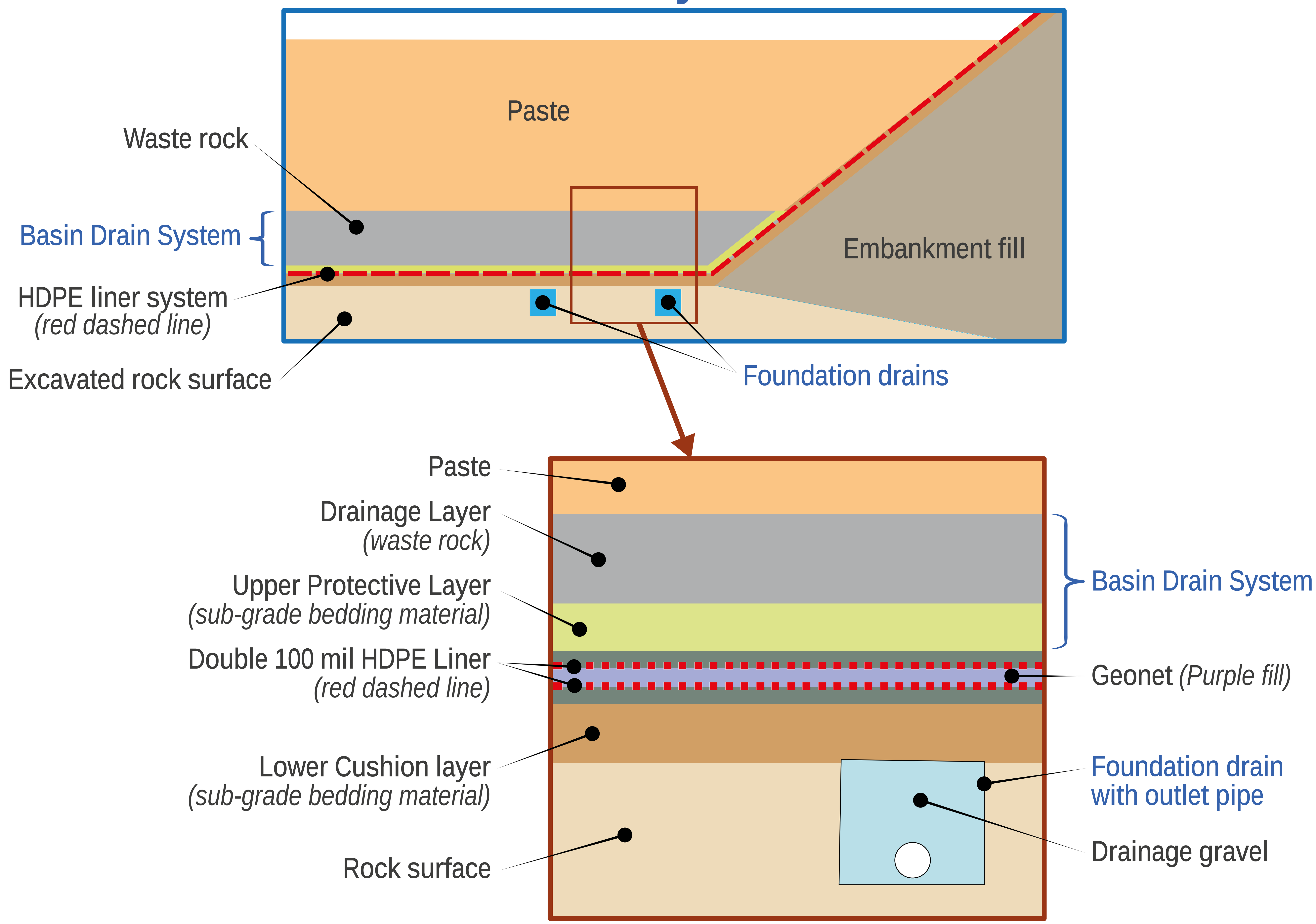
Cemented Paste Tails Lining System



Prepared by: Geomin using a Knight Piesold design (2017a)

Schematic Cemented Tailings Facility Sections with Lining System

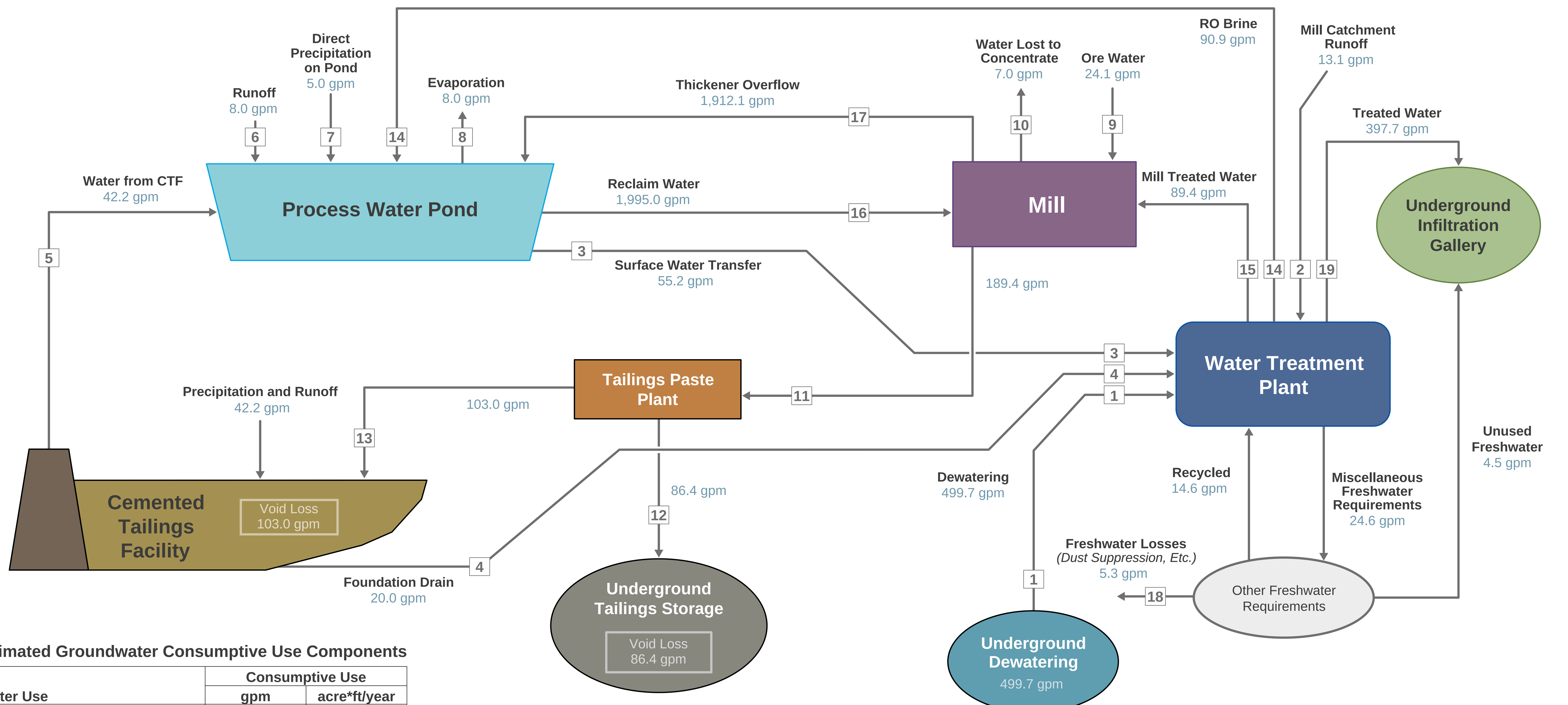
Drain collection systems



Prepared by: Geomin using a Knight Piesold design (2017a)

Annual Water Balance Schematic

Mean Case - Year 6



Estimated Groundwater Consumptive Use Components

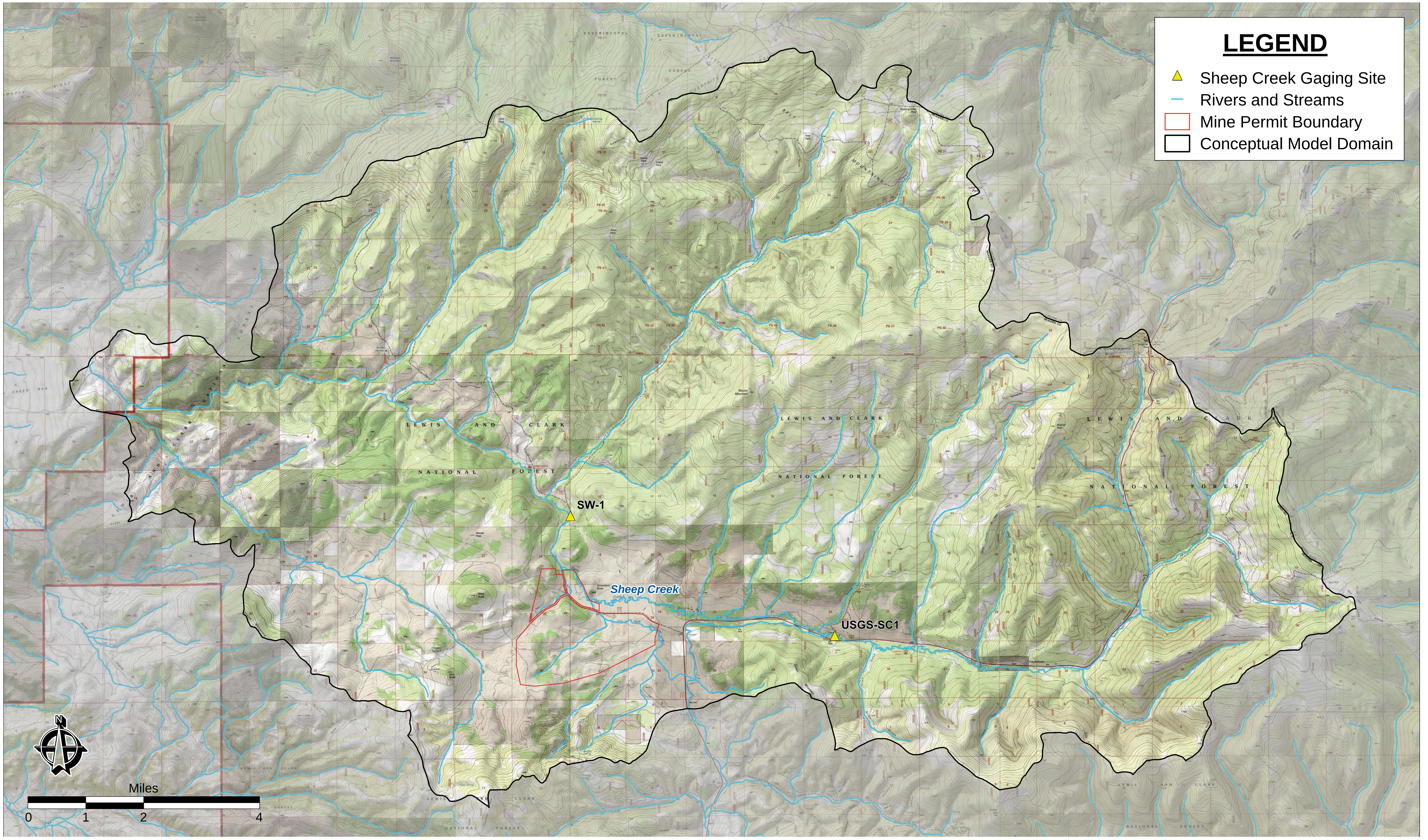
Water Use	Consumptive Use gpm	Consumptive Use acre*ft/year
PWP Evaporation	8	13
CTF Void Loss	103	166
Underground Tailings Void Loss	86	139
Water Loss to Concentrate	7	11
Freshwater Losses	6	9
Total Consumptive use	**210**	**339**

NOTES:

1. ALL WATER VOLUMES ARE EXPRESSED IN GPM EQUIVALENTS.
2. WATER IN TAILINGS PASTE IS ASSUMED TO BE UNRECOVERABLE.
3. SEEPAGE IS ASSUMED TO BE ZERO AS THE FACILITIES ARE LINED.

Prepared by Tetra Tech Inc. (March 2017)
Reference: Modified after Knight Piesold (2017): Report No. VA101-46-/3-2

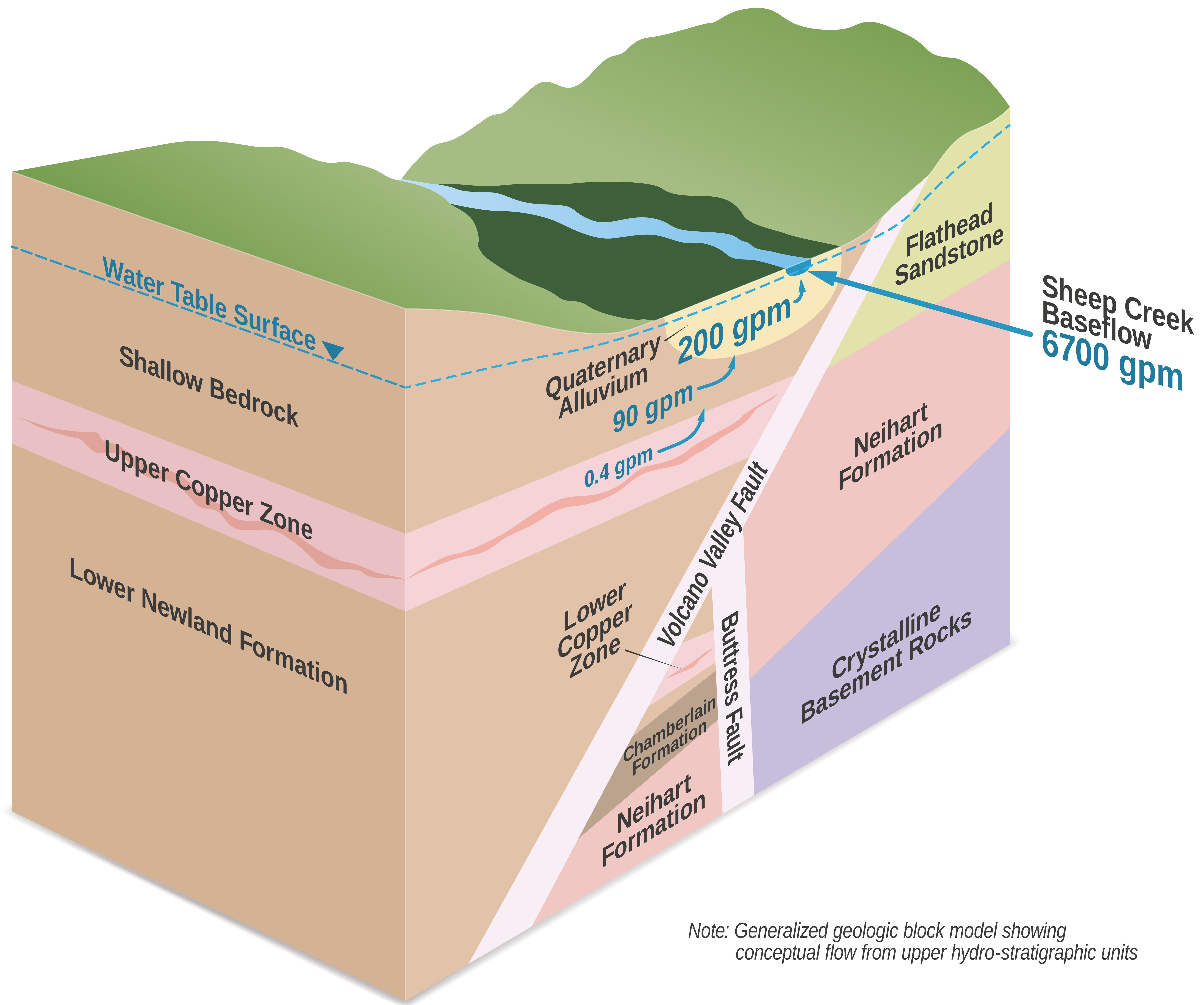
Conceptual Hydrologic Model Area



Date: November 9, 2015 Source: Hydrometrics (2015)

DEQ Montana Department of Environmental Quality

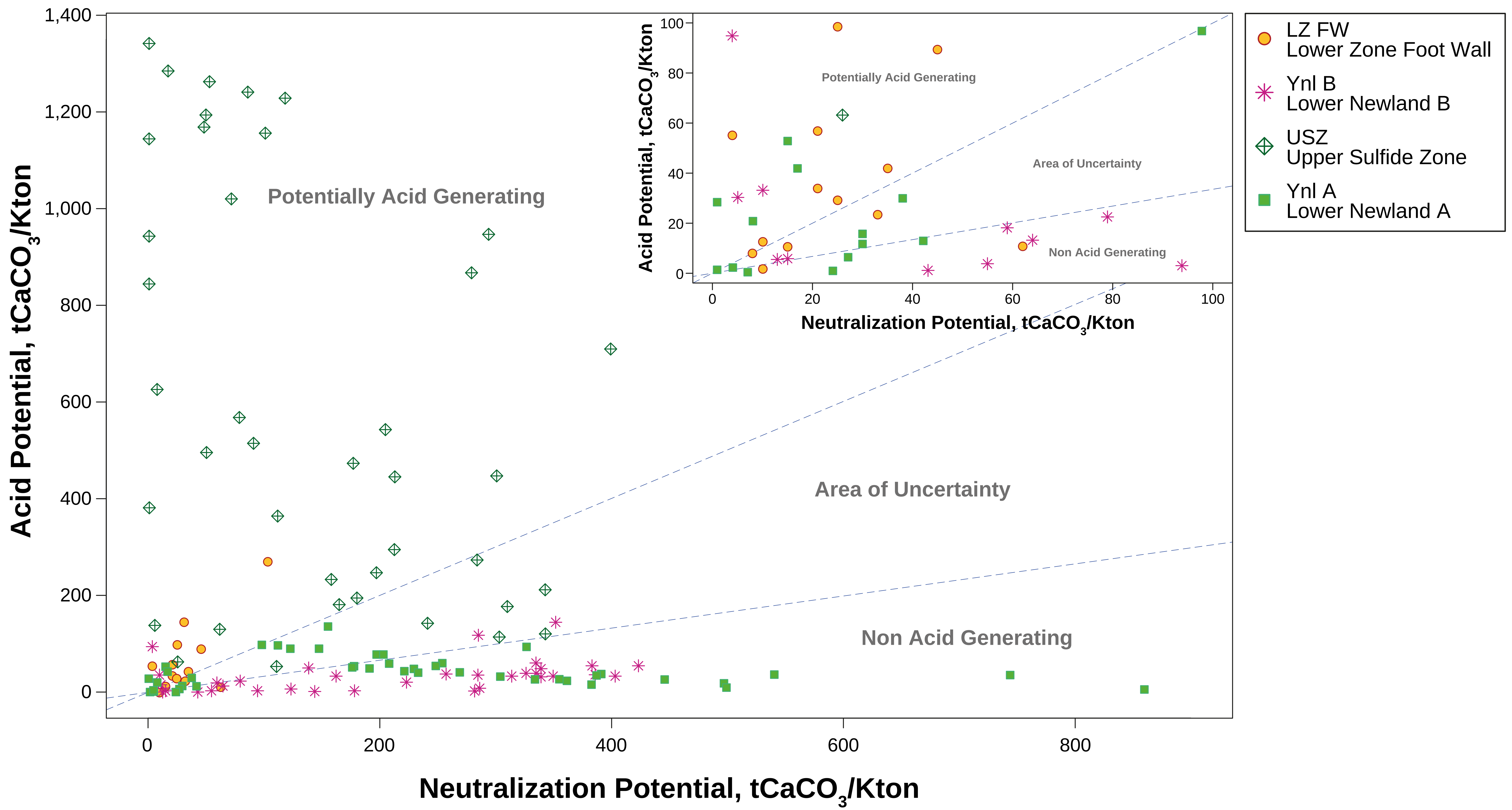
Block Flow Diagram



Note: Generalized geologic block model showing conceptual flow from upper hydro-stratigraphic units

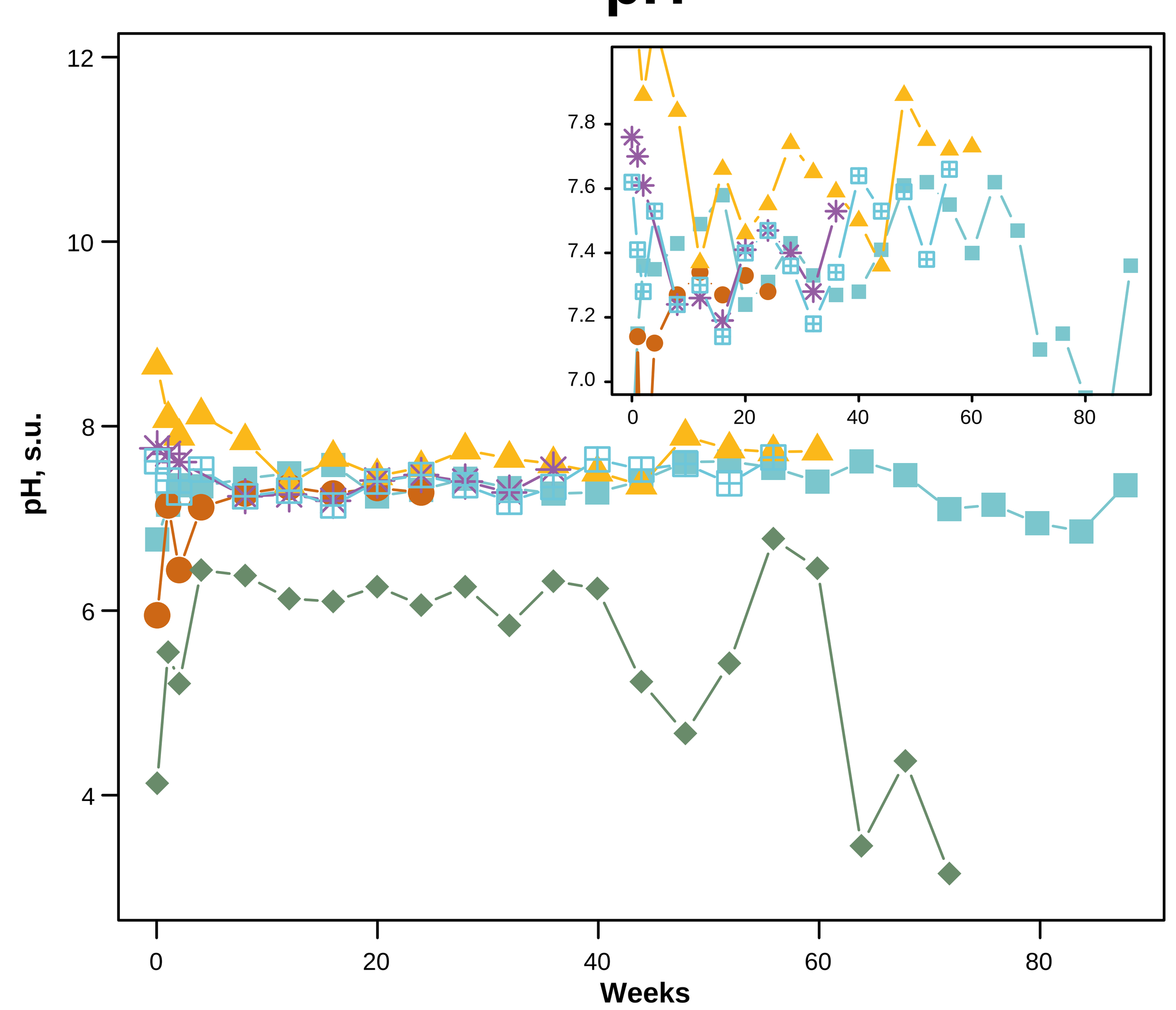
Prepared by Hydrometrics (2016)

Comparison of Neutralization and Acid Potential Data for Major Waste Rock Units

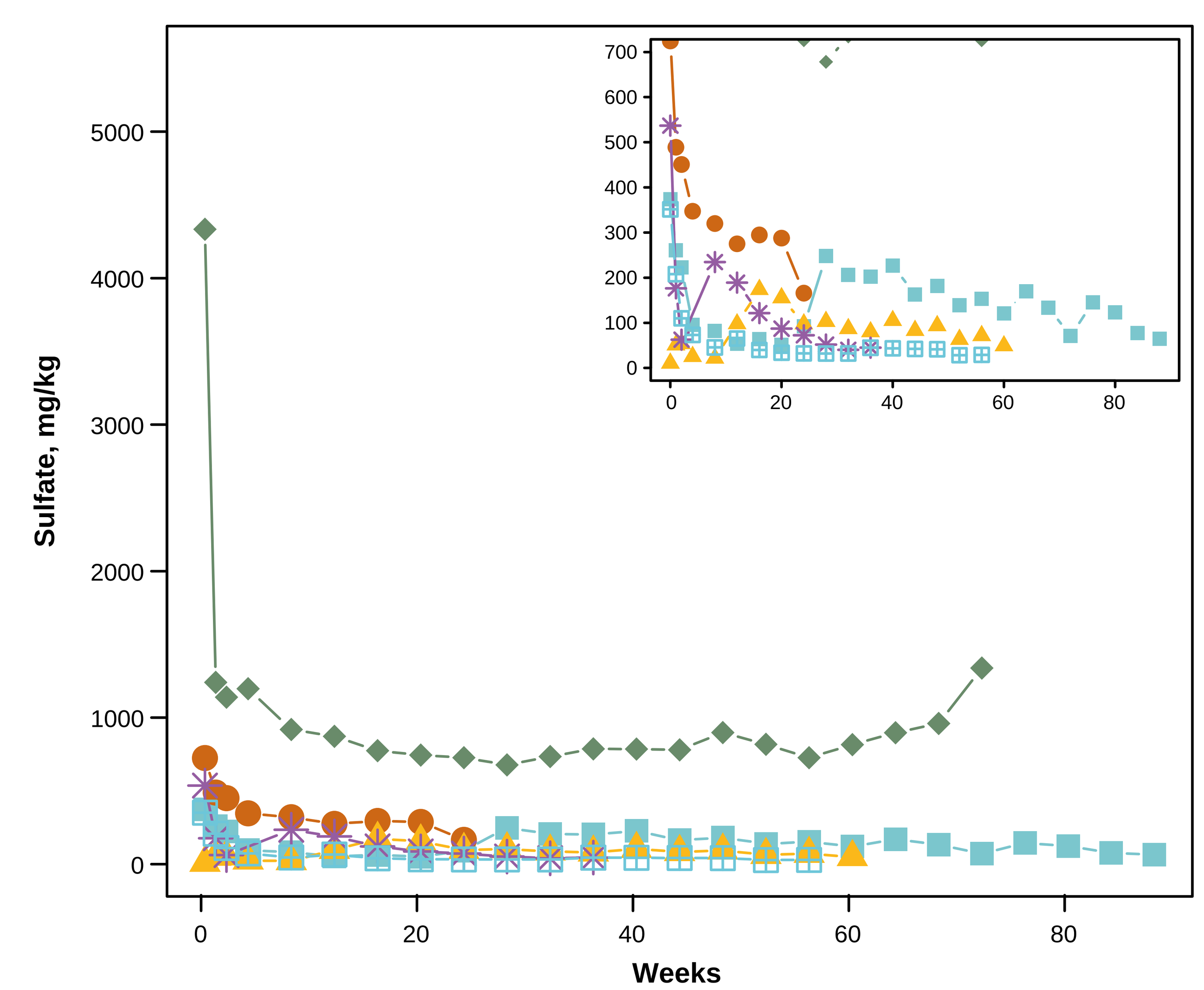


Comparison of Select Parameters for Waste Rock Kinetic Humidity Cells

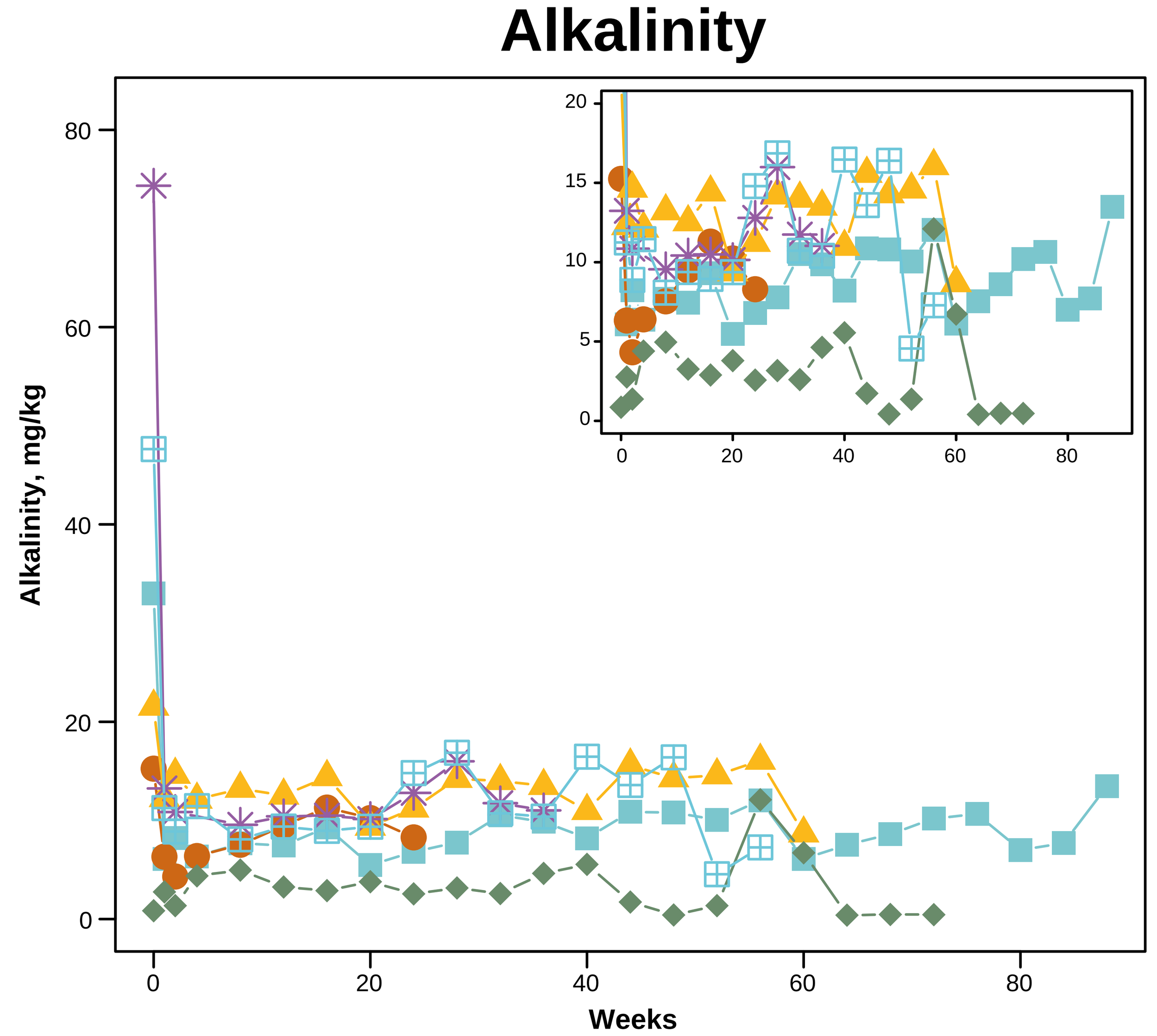
pH



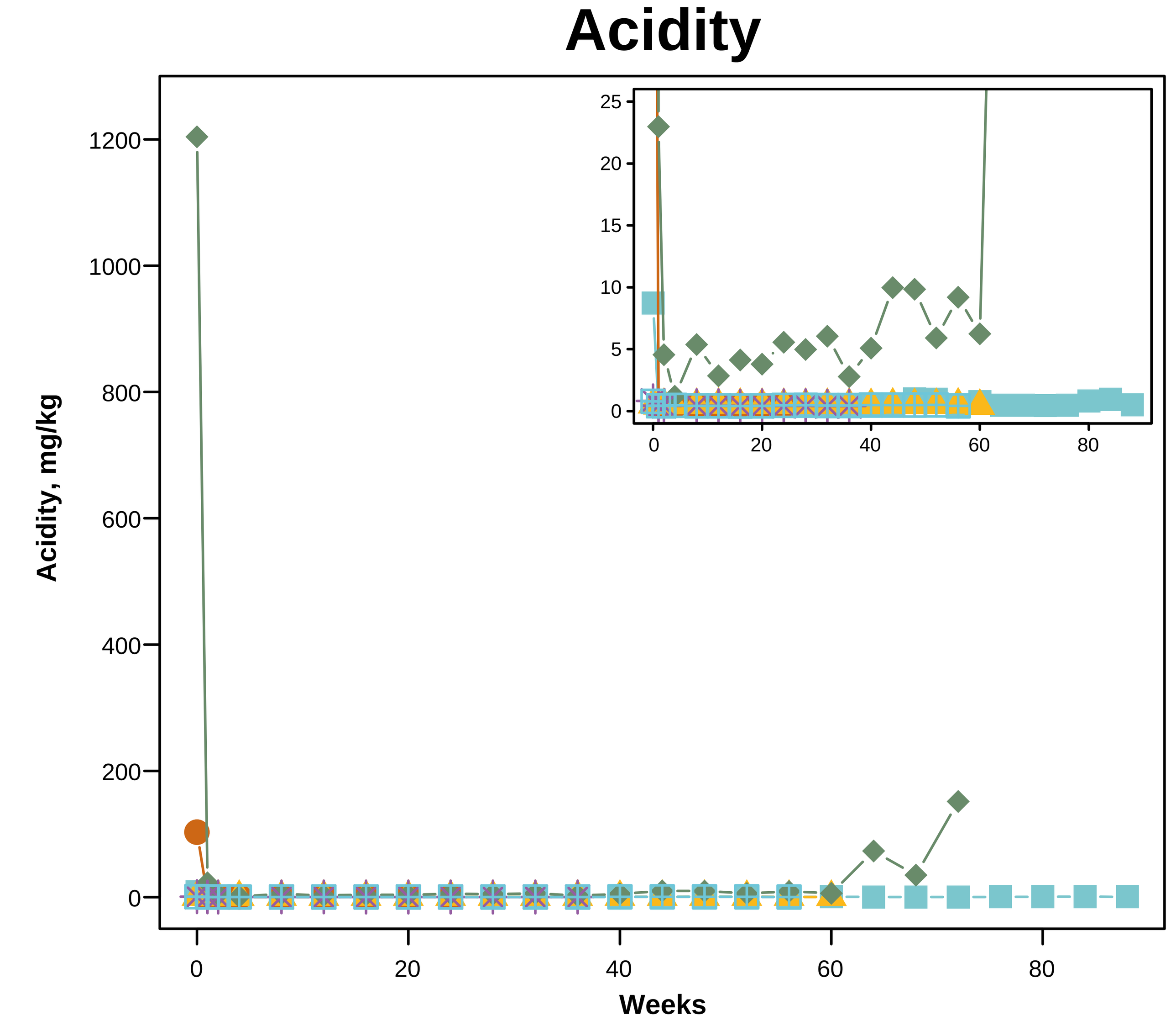
Sulfate



Alkalinity



Acidity

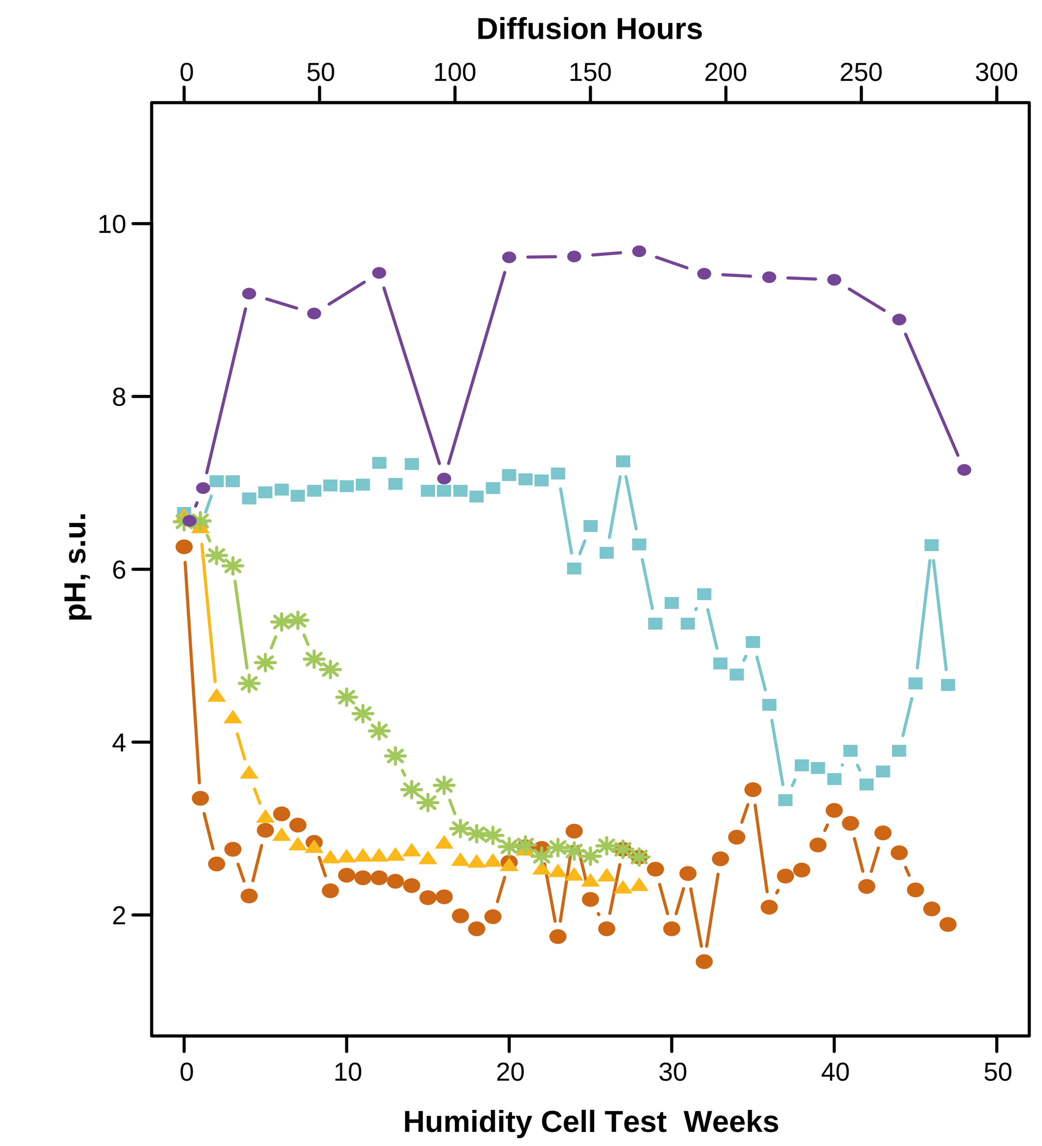


Note: Some data obscured in insets. All data visible in large figures; test durations varied.

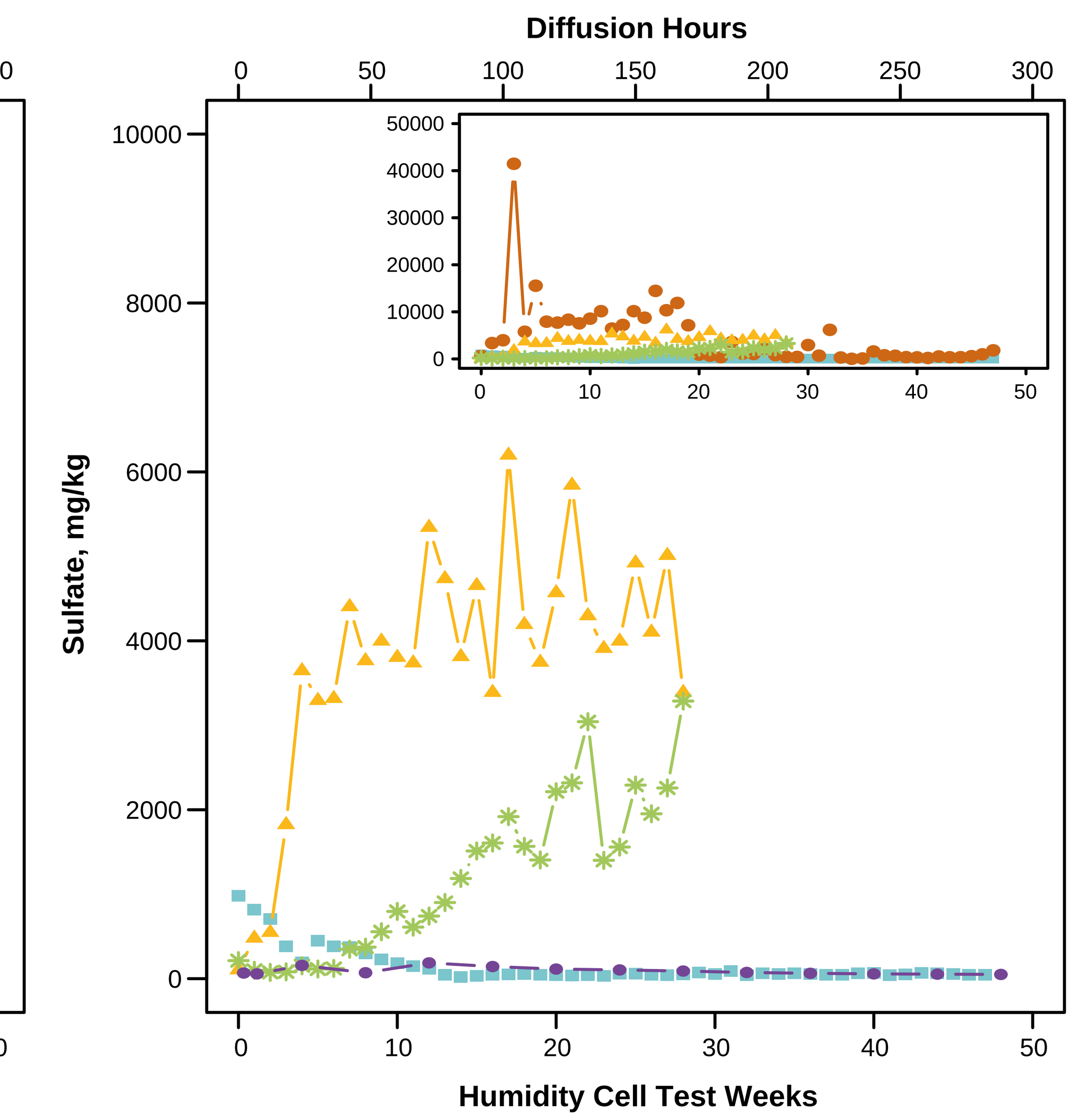
- 2012 Ynl A - Lower Newland A
- 2012 USZ - Upper Sulfide Zone
- 2012 Ynl B - Lower Newland B
- 2015 USZ - Upper Sulfide Zone
- 2015 Ynl B - Lower Newland B
- 2015 LZ FW - Lower Zone Foot Wall

Kinetic Test Results for Tailings

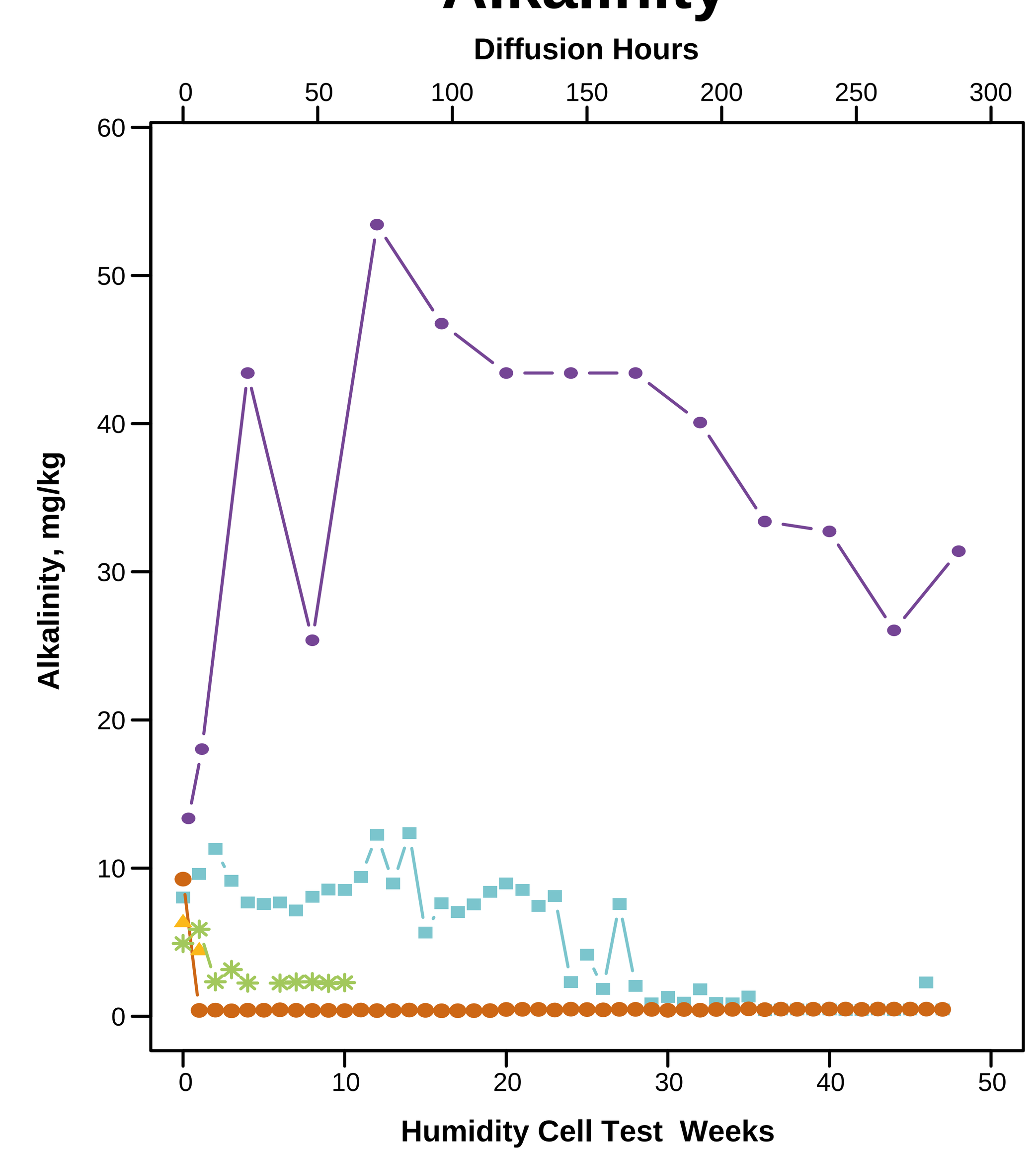
pH



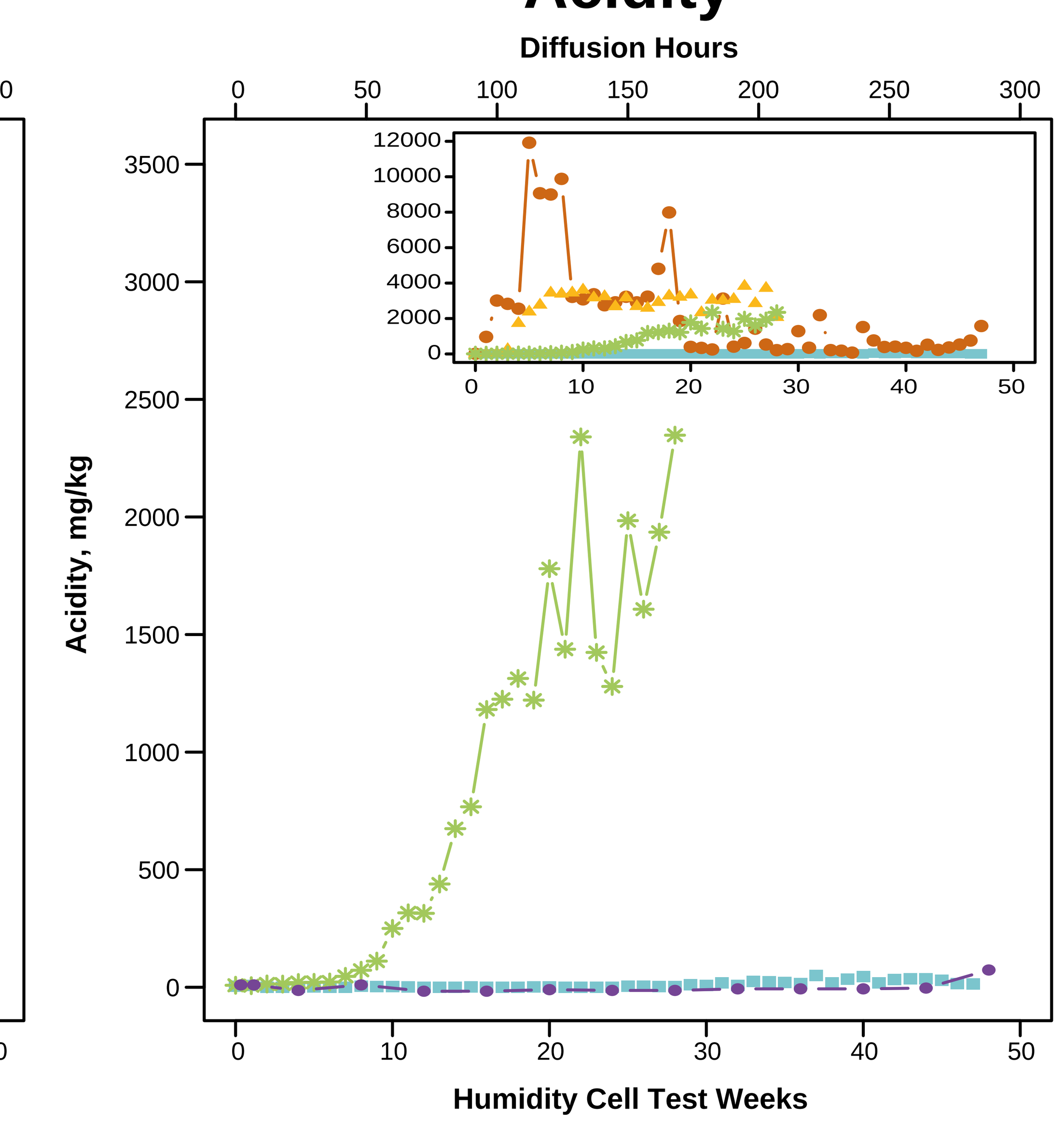
Sulfate



Alkalinity



Acidity



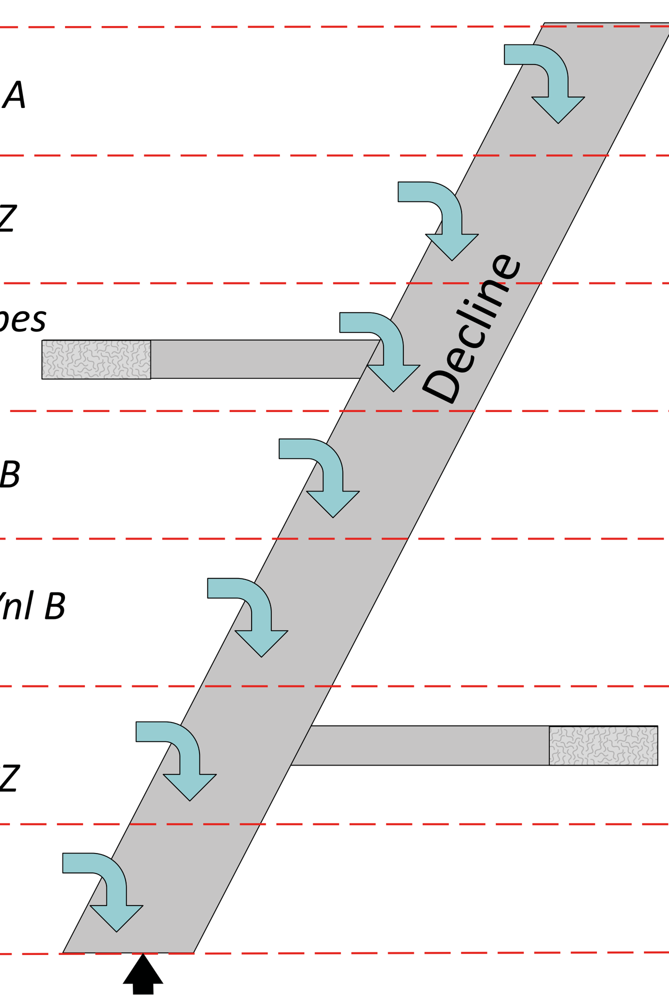
Note: To facilitate data interpretation, the Unsat. tailings HCT and 2% binders HCT acidity data are only presented in the inset with the expanded view of the y-axis. Diffusion Hours on upper x-axis only relate to 4% Diffusion test data in purple. All other data relate to the lower x-axis (Weeks).

- Saturated Tailings Humidity Cell Tests
- Unsaturated Tailings Humidity Cell Tests
- 2% Binders Humidity Cell Tests
- 4% Binders Humidity Cell Tests
- 4% Binders Diffusion

Conceptual Models

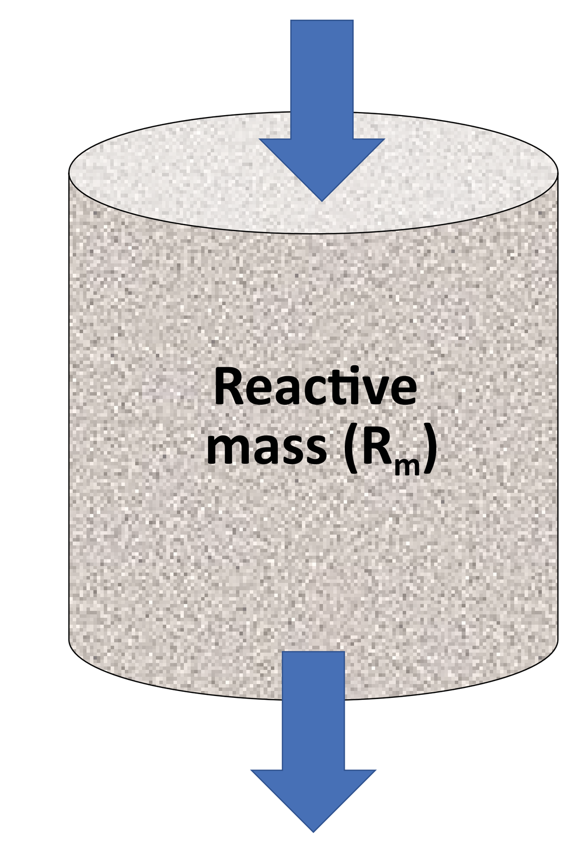
Conceptual Model of the Hydro-stratigraphic Units, with Flow to Mine Sump

Unit	Humidity Cell	GW Chemistry	Flow at yr 6 (gpm)
Decline Ynl A	*2012 Ynl*	*Avg (MW-1B, -2A, -2B, -4B, -9, PW-1 and -8)*	*102*
Decline USZ	*2012 USZ*	*PW-9 Avg*	*9*
Upper Ore access/stopes USZ/UCZ	*2015 USZ 4% Binder Diff.*	*Avg (MW-3, PW-2, PW-4)*	*274*
Decline Ynl B	*2012 YnlB*	*PW-10*	*13*
Lower Access Ynl B	*2015 YnlB*	*PW-10*	*119*
Lower Ore access/stopes LCZ	*2015 LZFW 4% Binder Diff.*	*PW-9 from UCZ, because data for PW-7 are poor*	*10*
Lower Zone Access Ynl B	*2015 LZFW*	*PW-10*	*17*

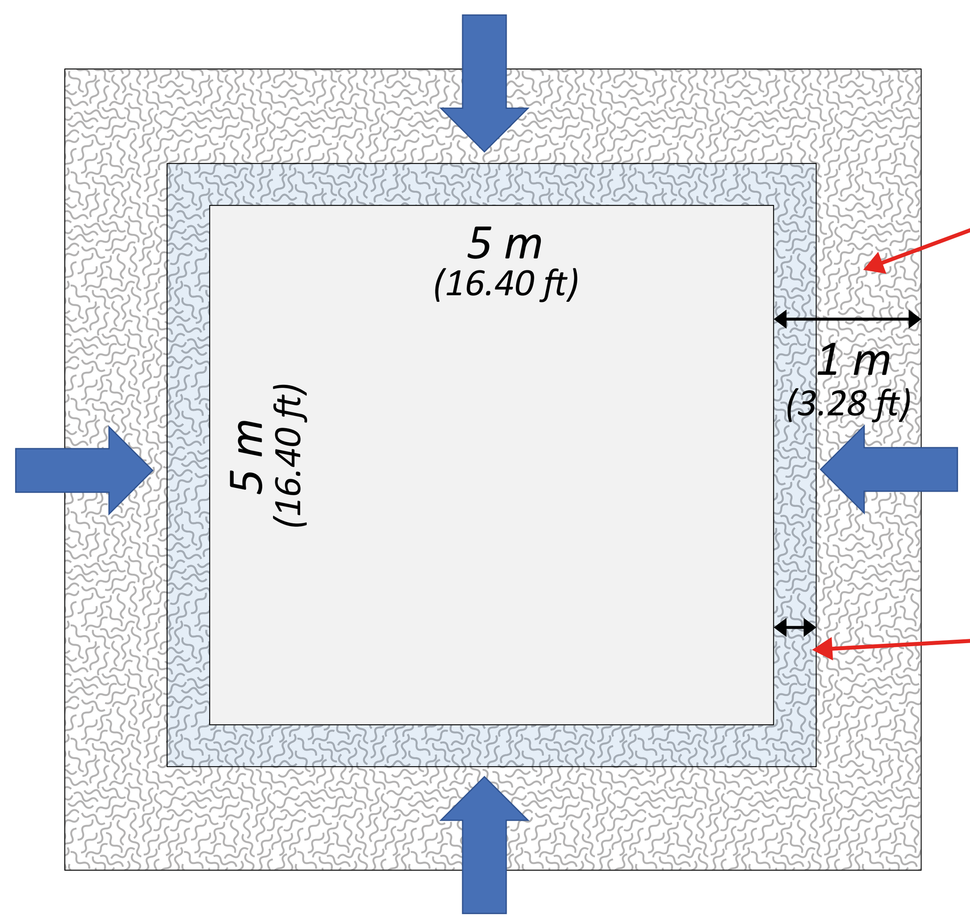


Predicted water quality in the sump

Humidity Cell Test



Conceptual Model of Reactive Surface Area in Underground Workings



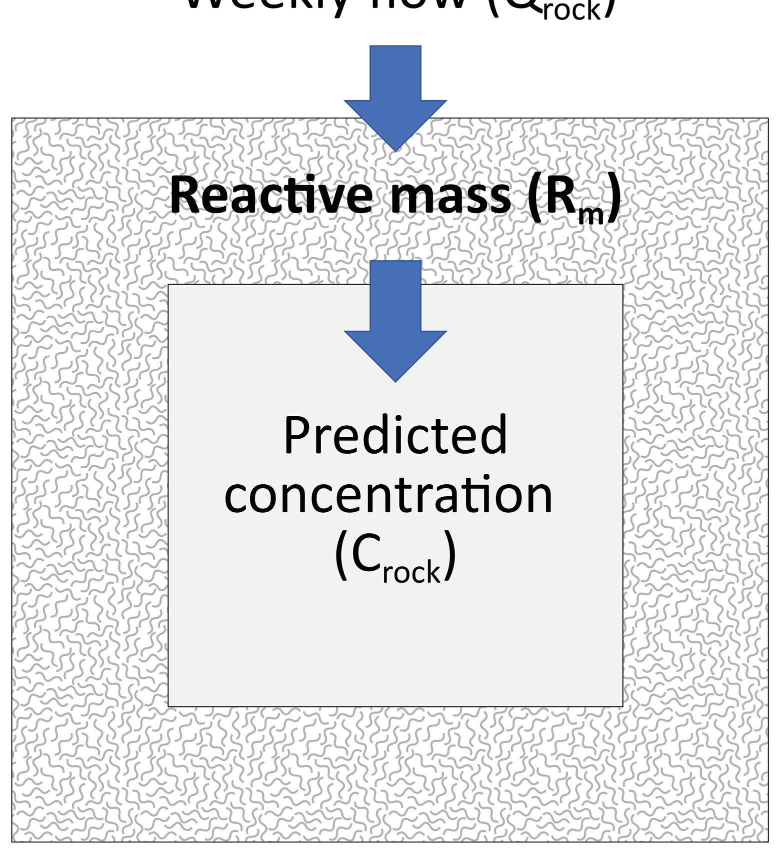
Blast-induced fracture zone
The base case maximum fracture zone is one meter (3.28 feet). Reported values are typically 0.3-1 m (0.98 to 3.28 feet)(Siskind and Fumanti), although typically <0.5 m (<1.64 feet) for low-charge methods (Kelsall et al.).

Oxidized rind (reactive zone)
The rind thickness increases as a function of time and sulfide content (i.e., oxygen consumption). The base case assumes that the rind increases according to sulfide oxidation (sulfate production),

$$2FeS_2(s) + 7.5O_2 + 7H_2O \leftrightarrow 4SO_4^{2-} + 2\,Fe(OH)_{3(s)} + 8H^+$$

at a rate of 6 kg $SO_4^{2-}/m^2/yr$.

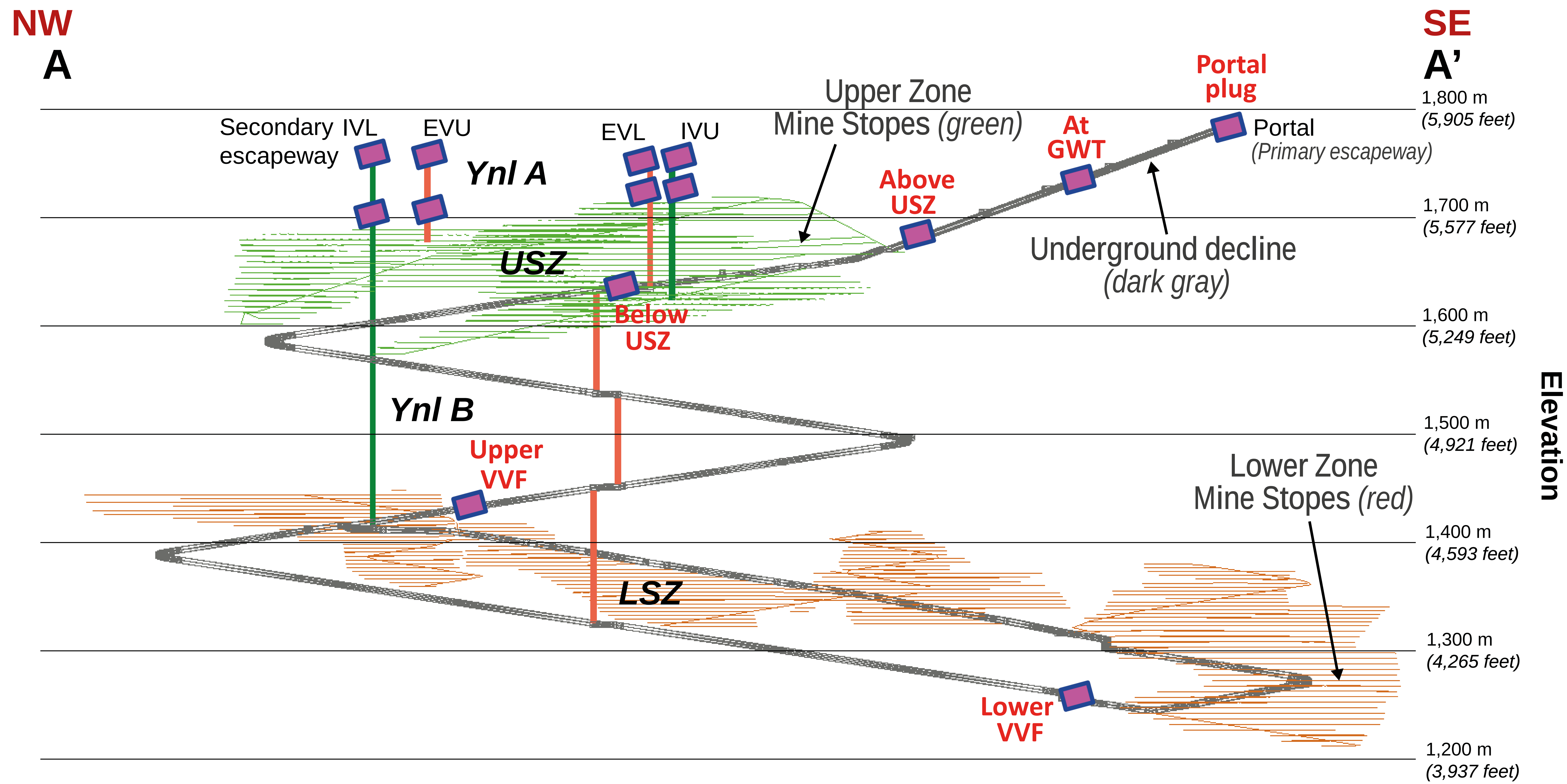
Wall Rock of Mine



Water Treatment Process Flow Diagram

Operational Phase

Cross-Section of Underground Workings Showing Hydraulic Barriers Installed in Closure



LEGEND

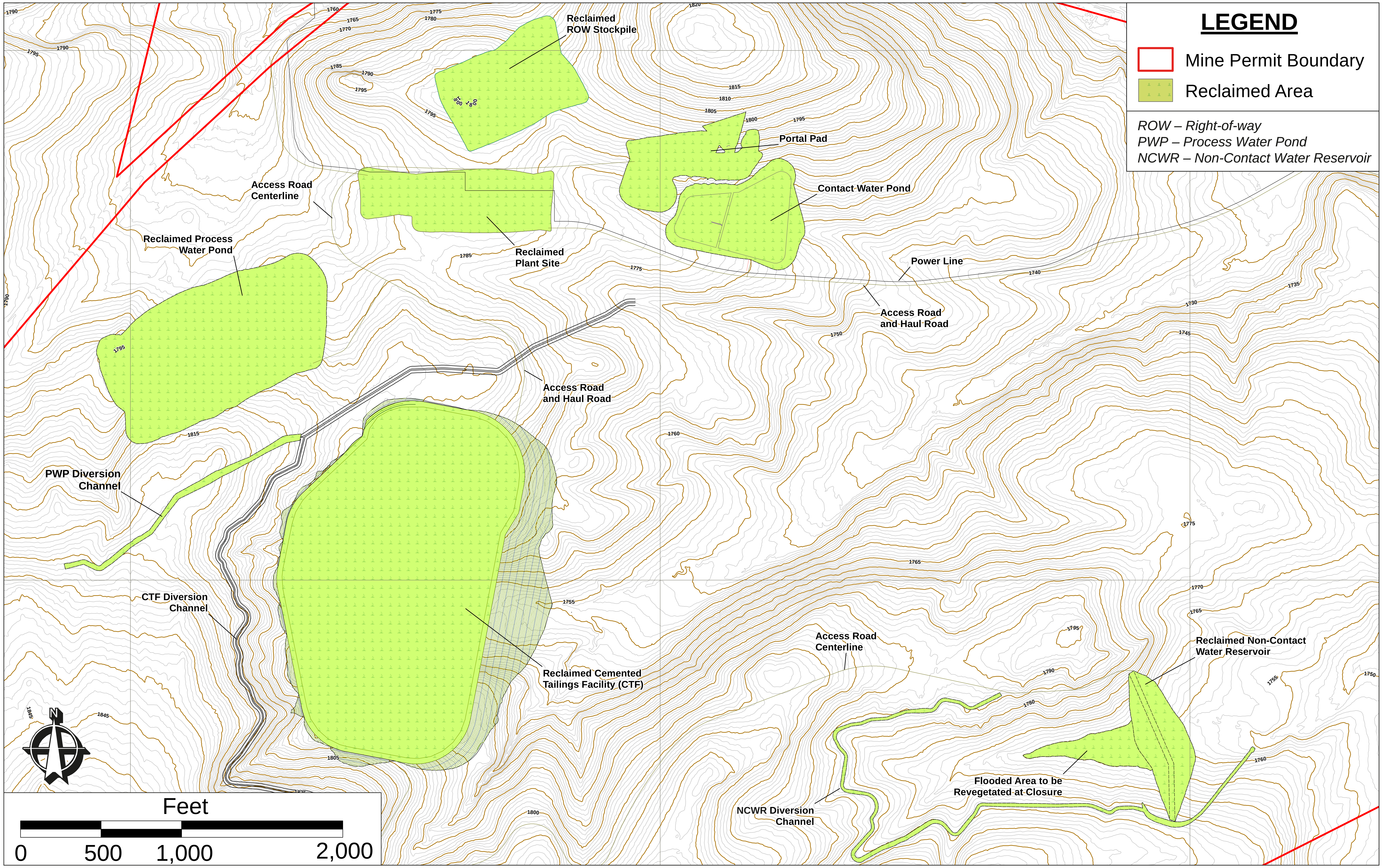
- Fresh Air Ventilation
- Exhaust Ventilation
- Upper VVF — Hydraulic barrier (or plug) installation

IVU = Fresh Air Intake Ventilation: Upper Copper Zone
IVL = Fresh Air Intake Ventilation: Lower Copper Zone
EVU = Exhaust Ventilation: Upper Copper Zone
EVL = Exhaust Ventilation: Lower Copper Zone

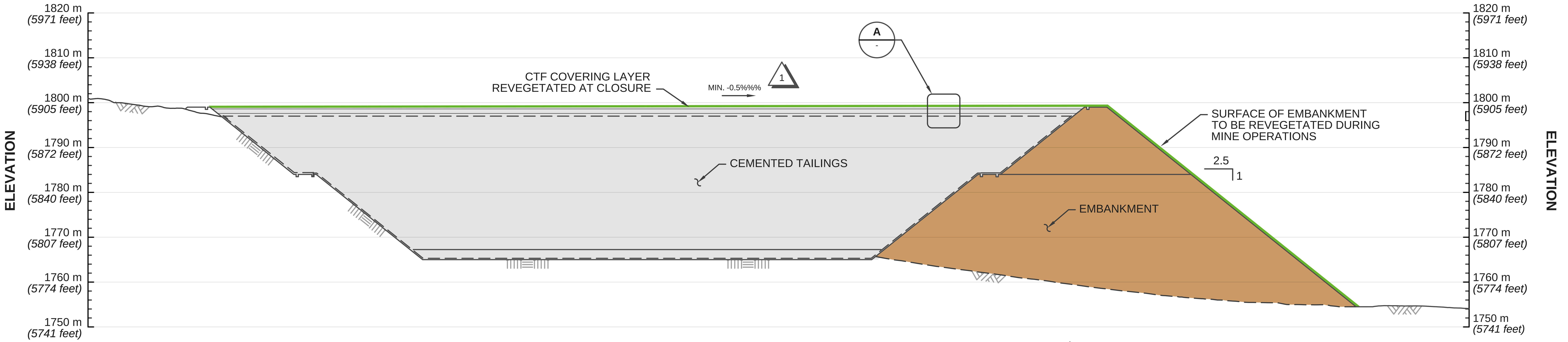
0 200 m
0 656 feet
SCALE

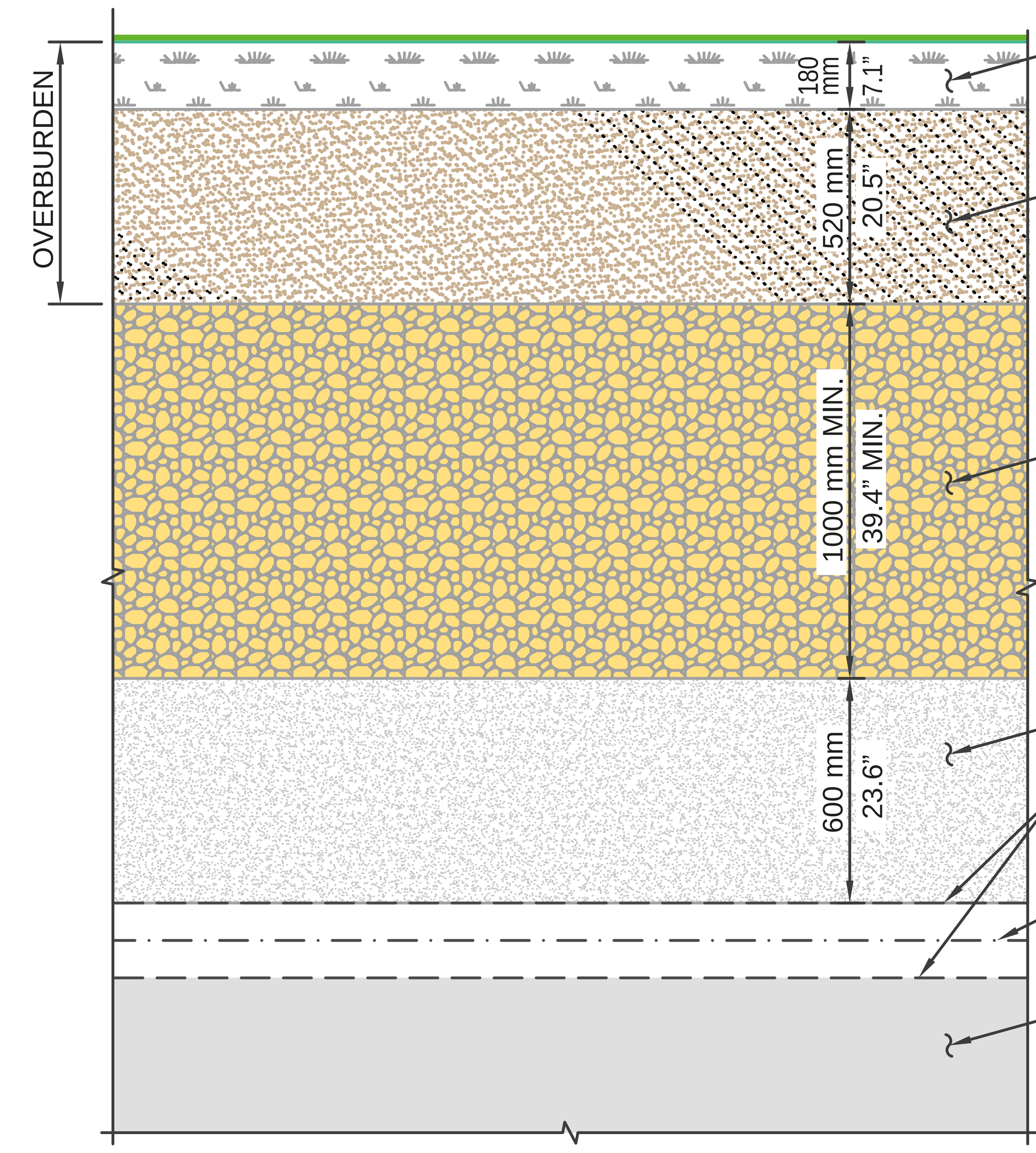
Prepared by: AMEC and TintinaResources (2017).

Post Closure Topographic Map



Cemented Tailings Facility Reclamation and Closure Cross-section





SECTION (1 / C8001)
HORIZONTAL: SCALE A
VERTICAL: SCALE B

SCALE A: 20 10 0 20 40 60 80 100 m / 65.6 32.8 0 65.6 131.2 196.8 262.4 328.1 feet

SCALE B: 10 5 0 10 20 30 40 50 m / 32.8 16.4 0 32.8 65.6 98.4 131.2 164.0 feet

DETAIL (A)
CTF CLOSURE COVER DETAILS
SCALE C

SCALE C: 300 150 0 500 1000 1500 mm / 11.8 5.9 0 19.7 33.4 59 inches

NOTES:

1. TAILINGS SURFACE WILL BE LEVELED USING SUB-GRADE BEDDING AS NEEDED.
2. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

Other DEQ Permits...

Montana Air Quality Permitting

Statutory Authority

- ❑ Clean Air Act of Montana
- ❑ Montana Code Annotated (Title 75, Chapter 2)
- ❑ Federal Clean Air Act

Rules

- ❑ Code of Federal Regulations (Likely 40 CFR 60, Subparts IIII and LL and 40 CFR 63 Subpart ZZZZ)
- ❑ Administrative Rules of Montana (Title 17, Chapter 8)

Tintina will be required to demonstrate compliance with state and federal air quality standards before a Montana Air Quality Permit can be issued.

Regulated Pollutants

Particulate Matter (PM, PM_{10} (<10 ug/m³), $PM_{2.5}$(<2.5 ug/m³))
Carbon Monoxide (CO)
Sulfur Dioxide (SO_2)
Oxides of Nitrogen (NOx)
Volatile Organic Compounds (VOCs)
Lead (Pb)
Miscellaneous Hazardous Air Pollutants (HAPs)

Montana Air Quality Permit required if potential to emit is greater than 25 tons per year of any regulated pollutant other than lead which is 5 tons per year.

Regulatory Time-line for Issuance of Montana Air Quality Permit

From the Receipt of an application for an air quality permit:

a) The Air Quality Bureau (AQB) will have 30 days to determine the application “complete” or ask for additional information.
b) Once the application has been deemed complete, AQB will have 40 days to issue a “Preliminary Determination”. The Preliminary Determination will be out for a 30-day public comment period.
c) Once the Project EIS and Record of Decision (ROD) are final, AQB will issue a final decision within 30 days of the Final EIS/ROD date. AQB will issue the Final permit following a 15-day appeal period.

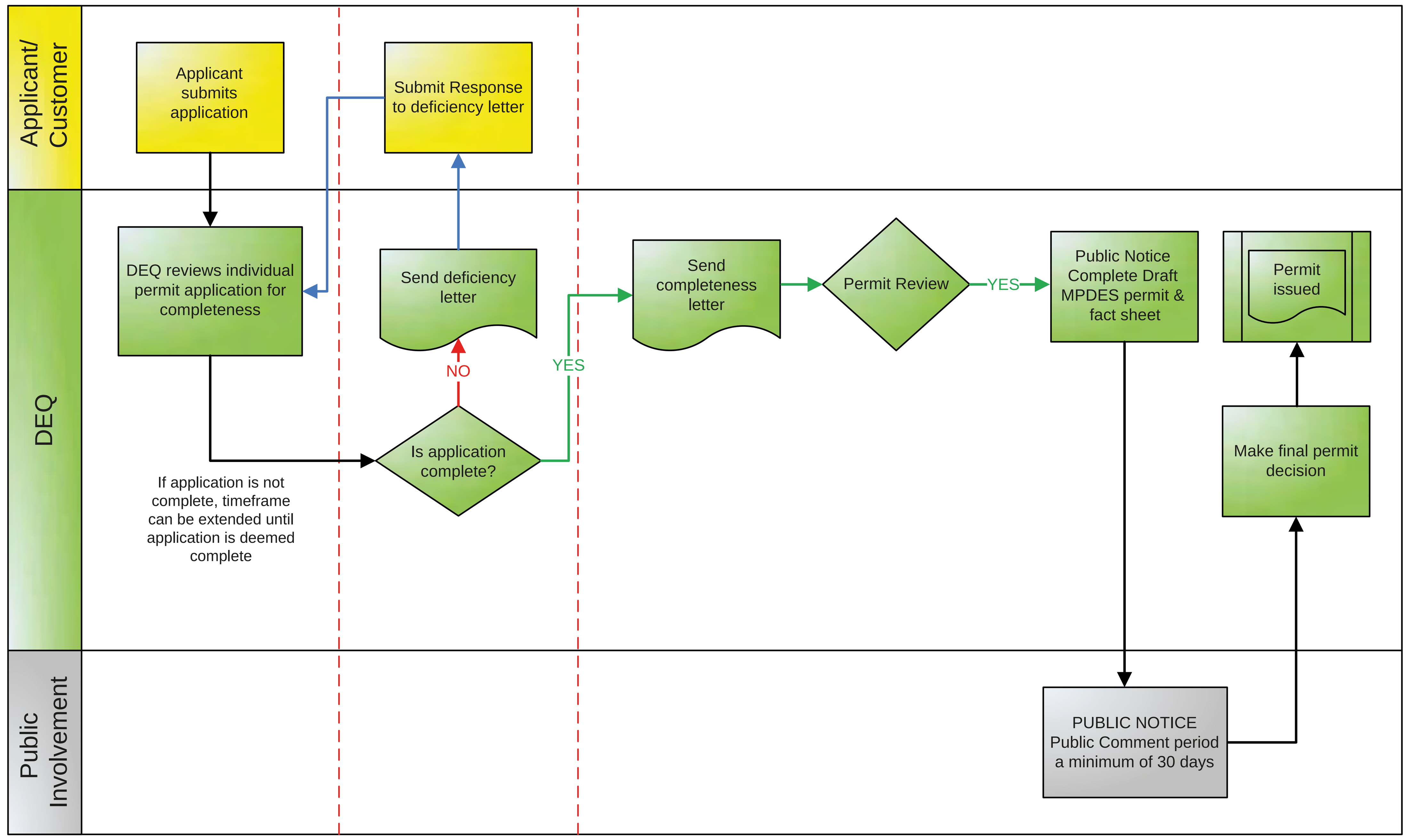
Current Tintina Air Quality Application Status

Ask for current status – as an application may now have been submitted.

DEQ Public Water Supply Process:

- Applicant submits Plans and Specifications to DEQ
- DEQ reviews the plans for compliance with Design Standards in Circular DEQ-3
- DEQ issues a Public Water Supply approval
- After construction is complete, applicant submits as-builts to DEQ
- For more detailed information please visit: *http://deq.mt.gov/Water/pwsub/pws/PlanReviewEngineer*

MPDES Permit Process



For more detailed information please visit: *http://deq.mt.gov/Water/WPB/mpdes*

APPENDIX E

List of Commenters

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Name of Sender	Organization	Street Number and Name	City	State	Zip
A Johnston					60202
A l					14809
A Lynn Raiser					32259
a miller					90404
A. Morris					
A. W.					10507
Aaeron Robb					21218
Aart Doleman					
Aberic					
Abigail Gindele					3801
Abigail Rome					20910
Adair DeLamater					4530
Adam D'Onofrio					23803
Adam Johnson					53705
Adam Trauger					90815
Adella Albiani					95946
Adi S					28804
Adina Parsley					98292
Aditi Sundarajsn					75081
Adnana Mihaela					99999
Adriana Guzman					03810
Adriano Janeži?					1370
Adrienne Altman					91355
Adrienne Kovasi					95521
Adrienne Ross					87540
Agnieszka Beletsky					21631
Aimee kardulas					3903
Aixa Fielder					90028
Akankha Perkins					5091
Al Gedicks					54603
Alan Bedard					2003
Alan Canfield					80915
Alan Goggins					94546
Alan Haggard					92105
Alan Harper					23225
Alan Jasper					11566
Alan McKnight					12495
alan papscun					1229
Alan Schwartz					93035
Alan Wojtalik					21234
Alana Willroth					55110
Albert Miller					92604
Alec Underwood	Montana Wildlife Federation				
Alecia Jongeward					
Alejandra Vega					1414
Alessandra Paolini					20134
Alessia Fiandaca					20141
Alex Eby					
Alex Stavis					10128
Alex Vollmer					94901
Alexander Henrich					22457
alexander palloc					48209
Alexandra Cordeiro					
Alexandra Meyer					82194
Alexia Jandourek					54944
Alfred Mancini					1876
Alfred Staab					67205
alice jena					11418
Alice Petersen					43623
Alice Polesky					94107
Alicia Addeo					33702
alicia divens					21742
aline prada					56220
aline Roaux					31400
Alison Cobb					
Alix Keast					10025
Allan Booyjzsen					46545
Allen Salyer					48085
allenbohnert					
Allie Crowder			Helena	MT	
Allie Tennant					33905
Allison Castle					52761
Allison Rensch					SE18 2BA
allison scheflow					33021
Allison Vidito					
Alva Pingel					55068
Amanda gordon					32773
Amanda Melrood					53207
Amanda Tenney					91201
Amber Coverdale Sumrall					95073

Name of Sender	Organization	Street Number and Name	City	State	Zip
Amber Haseltine					60139
Amy Cherry					10025
Amy Dombek					6033
Amy Greer					10463
Amy Haines					53403
Amy Hansen					08802
Amy Heyneman					98110
Amy Holt					53711
Amy Mueller					14414
Amy Norris					02738
amy pick					12561
Amy Smereck					4843
Amy Thompson					2139
An Chadwick					85719
Ana Herold					94044
Ana Herrero					78260
Ana N					10019
Ana Zapatero Villar					08930
Anabel Royer					93428
Anais Deroint					13090
Ana-Paula Martins-Fernandes					94065
Anastasia Hanifan					11801
Andrea Cimino					20895
Andrea Hall					07438
Andrea Kilcher					3427
Andrea Lewis					08690
Andrea Neal					13045
Andrea Rohr					60598
Andrelene Babbitt					18069
Andrew Fisher					19006
Andrew Gold					87701
Andrew Jackson					77047
Andrew Levin					21136
Andrew Mitchell		P.O. Box 1991	Livingston	MT	59047
Andrew Sledd					60643
Andy Johnson		Box 1006	Butte	MT	59703
Andy Lupenko					91945
Anette Klang					29493
Angela Leventis					16866
angela melitopoulos					10997
Angela Spotts					87558
Angela Stuebben					8844
Angela West-Piotrowski					92119
Angelica Palomo					60622
Angelika Altum					76522
Angelika Blochwitz					33098
angelika eberl					10138
Angelique Delattre					91100
Anita Coolidge					92007
Anita Faulkner					75007
Anita J. Brawner		56 Deep Creek Rd	Livingston	MT	59047
Anita Buffer					18974
ann atkin					EX22 7LQ
Ann Bein					
Ann Bicking					23236
Ann Christensen					83340
Ann DeMerlis					19002
ann despont					07945
Ann Healy					89134
Ann Kelly					8054
Ann Marie Kuter					18976
Ann McMullen					84093
Ann Quota					10520
Ann Rowell					28211
Ann Wilsnack					
Ann Wilson					37030
Ann Wiseman					61854
Anna Astarkina					
Anna Brewer					87107
Anna Camarata					32751
Anna Cruikshank					45506
Anna Hergott					48045
Anna Petrov					97007
Anna Shaughnessy					44041
Anna Tangi					19148
Annah Gardner					55403
Annamay Waldman					34982
Anne Bekkers					0
Anne Burnett					50211
Anne Easterling					76051

Name of Sender	Organization	Street Number and Name	City	State	Zip
Anne Haflich					66614
Anne Moeller					29401
Anne Pinkerton					19460
Anne Prost					33930
Anne Rutten					01325
Anne Streeter					H3R 2R9
anne veraldi					94110
Annette Pieniazek					
Annick Somerville					28700
Annie Belt					95126
Annie Bien					11231
Annie Hanson					W12 0BH
Annie McCuen					97302
Annie Wei					04870
Anthony Albert					97330
Anthony Lyons					74701
Anthony Mehle					44406
anthony montapert					93004
Anthony Somkin					94708
Anthony Straka					12590
Antonella Nielsen					2400
António Benigno					44000
Antonio Garcia-Palao					28001
Antonio Sarmiento					62200
Antony Chapman					93012
Anusch Ricaud					
Apl Kont					0
April Keating					26201
April Silverman					18938
April Smith					
Ardeth Weed					98020
Ariel Avelar					29732
Ariel Heron					99502
Arkady Vyatchanin					32607
Arlene Aughey					7663
Arlene RUKSZA-LENZ					60707
Arlene Zuckerman					11375
Armando Aranjo					92084
Arnold Haber					78732
art felsinger					85281
Art Hanson					48917
Art Schlinger					56444
Art Wilkinson					55119
Arthur & Lois Finstein					01701
Arthur Noble					97411
Ashley Lewis					94930
Astrid Suchanek					18146
Audrey Huzenis					10023
Aurora Navarro					95927
aussiegail					
austin.kriz					
Ava Isaacson					83702
Aven Satre-Meloy					
Avis Deck					67002
Avis Ogilvy					70118
Aviva Shliselberg					12569
b eww					94973
B P					Y1A 5G5
B. Thomas Diener					87123
Baker Smith					98168
Bambi Magie					08724
Barb Crumpacker					83814
Barb Fitzgerald					14217
Barbara and Jim Dale					52101
Barbara Bernstein					97202
Barbara Burgess					94559
Barbara Cohn					92010
Barbara Conrad					55042
Barbara Eshbaugh					
Barbara Fletcher					75235
Barbara Ginsberg					95062
Barbara Graham					92110
Barbara Graper					93465
Barbara Gross					98115
Barbara Hatcher					10605
Barbara Kantola					49120
Barbara Kiver					98221
Barbara Mathes					85648
Barbara McKee					98664
Barbara Miller					7416

Name of Sender	Organization	Street Number and Name	City	State	Zip
Barbara Murray					90041
Barbara Nagy					90503
Barbara Rosenkotter					98243
Barbara Scholl					43130
Barbara Slinker					22303
Barbara Smith					96722
Barbara Stenross					27510
Barbara Stow					49616
BARBARA SWYDEN					87124
Barbara Ullian					97527
Barry Cutler					19064
Barry Medlin					37830
Barry Miller					85053
Barry Rabichow					60302
Beatrice Narbona					7800
Beatrice Simmonds					10462
Becky Bilokur-Tobias					78660
Becky Daiss					22201
Becky Monger					48108
Ben Bain					
Ben F Garcia					80206
Benigno Fuentes					
Benita Musleve					44306
Benjamin Allen					21114
Benjamin Joannou Jr					33156
Bennie Scott					72634
Bente Petersen					
Bernadette Andaloro					13057
Bernadette van der Loo					08195
bernard Rafferty					12542
bernardo alayza mujica					51111
Bert Giskes					9734BJ
Bert Lindler			Missoula	MT	
Bert Williams		5500 Hwy 89	White Sulfur Springs	MT	59645
beth and mark peterson					97523
Beth Braun					60640
Beth Chao					66047
Beth Darlington					12604
Beth Goode					
Beth Pfaff		6501 Leverich Lane	Bozeman	MT	59715
Beth Stanberry					28802
Beti Webb Trauth					95503
Betsey Porter					55431
Betty Ghee					54476
Betty Kowall					94951
Betty Stewart					23608
Betty Winholtz					93442
bevan early					v0g1h0
Beverly Antonio					21617
Beverly Linton					2476
Beverly Simone					10994
Beverly Villinger					59715
bill					
Bill Boyle					59112
Bill Christie					85719
Bill Galt	Galt Ranch	543 Birch Creek Road	White Sulphur Springs	MT	59645
Bill Gardner					95942
Bill Geer	Montana Wildlife Federation	619 1st Street	Helena	MT	59601
Bill Giese					52402
Bill Holder					
Bill Jones			Stevensville	MT	
Bill Leikam					94306
Bill Nelson					95409
Bill Rubin					30339
Bill Story					
Bill Sugars					
Bill Vom Weg					
Billy Angus					59840
Bindi Binkley					80026
Birgitta Granholm					85235
Blair Kangley					98199
Blaise Brockman					91007
Blanca Luz Ross					92833
blanchase					
Bo Breda					96778
Bob Balhiser		735 Corral Road	Helena	MT	
Bob Bowland					
Bob Brucker					34208
Bob Kelly	Mayor of Great Falls				
Bob Kelly	Mayor of Great Falls				

Name of Sender	Organization	Street Number and Name	City	State	Zip
Bob McDowell					
Bob Rosenberg					94904
Bob Routa		P. 0. Box 789	White Sulphur Springs	MT	59645
Bob Sager		P.O. Box 614	White Sulphur Springs	Montana	
Bob Sager					
Bob Shippee					23233
Bob Steininger					19460
Bob Thomas					97457
bob Yancey					62086
Bobbi Fowlie			White Sulphur Springs	MT	
Bobbi Jo Fowlie		PO Box 510	White Sulphur Springs	Montana	
Bobbie Knight					80239
Bonnie Blitzstein					90035
Bonnie Gestring	Earthworks	1612 K Street NW, Suite 808	Washington	DC	20006
Bonnie Gestring	Earthworks	140 South 4th Street West	Missoula	MT	59801
Bonnie Hamilton					17339
Bonnie Hoffman					
Bonnie Kenny					80214
Bonnie O'Connor					81147
Boo Turner			Mazama	WA	
Brad Hansen					
Brad Hicks					
Brad Shepard					
Bradley Budnik					60076
Bradley Smith					33909
Brady Hurley					81612
Brain Flores					94546
Brandon Boedecker					
Brandon Kozak					62025
Brandy Schumacher					95610
Brant Kotch					77024
Brenda Lewis					98816
Brenda Michaels					98027
Brenda Thompson					91942
Brett Mitchell					46528
Bri Williams					92036
Brian Dawson					92603
Brian Field					80260
Brian Gingras					2184
Brian Henning					55431
Brian K Sutton					40242
Brian Kuru					
Brian Neilsen	Trout Unlimited				
Brian Obert	Montana Business Assistance Connection				
Brian Ohs			Pony	MT	
Brian Thompson	Montana' Contractor's Association				
Bridget Spann					1267
Bridget Wyatt					97206
Brieaux Poche					70454
Bronwen Rossiansky					74410
Bronwyn Mills					53183
Brooke Kane					22101
Bruce Cross					60201
Bruce Cutts					80634
Bruce Farling		232 West Sussex	Missoula	MT	59801
Bruce Grobman					95062
Bruce Higgins					30318
Bruce Hlodnicki					46226
Bruce Krawisz					54449
Bruce McGraw					92104
Bruce Perry					72762
BRUCE ROE					61084
Bruce Trout					21042
Bruce Wade					
Bryan Bell					98362
Bryan Duncan					
Bryan Glassing	Industrial Sales	1224 Cordova	Billings	MT	59101
Bryan Wyberg					
C Emerson					95816
C Janzen					
C. Cantrell					
C. Collins					5641
C. Kasey					23116
C. Mendel					43214
C. Wilcox					60050
C.A. Rose					
Caitlin David					44121
Cal Mendelsohn					10954
Callie Bagdon					01038/9737
Callie Riley					95610

Name of Sender	Organization	Street Number and Name	City	State	Zip
Camie Rodgers					30813
Cammarota Louise					13010
Cammy Colton					66223
Canan Tzelil					90210
Candace Bassat					08722
Candace McCann					79912
Candace Rocha					90031
Candace Russell					85035
Candace Smith					
Candy Frantz-Crafton					95065
Cara Gubrud					56353
Cara Schmidt					72687
Carine Bellemans					1502
Carl Clark					59404
Carl Pflug					07735
Carl Skipworth					33021
Carla Behrens					80503
Carla Cicchi					
Carlene Estacion					86336
Carlene Meeker					10024
Carlos Arnold					93455
Carlos Castro					111211
Carlos Nunez					91335
Carmen Chacon					83202
Carmen Plaza					33020
Carmine Dileo					08846
Carol Ann Brady					19481
Carol Baier					92103
Carol Becker					91423
Carol Berard					49085
Carol Berkeley					1921
Carol Book					17406
Carol Chappell					12440
Carol COLLINS					19904
Carol Dearborn					30552
Carol DeSanto					18616
Carol Devoss					60174
Carol Dodson					29045
carol elias					13662
Carol Else					98498
Carol Fox					
Carol Gelfand					15237
Carol Hewitt					90755
Carol Hospador					34209
Carol Johnson					80123
Carol Lilleberg					94559
Carol Lloyd					85749
Carol Masuda					60202
Carol Metzger					23084
Carol Rahbari					48197
Carol Rideout					2318
Carol Storthz					72202
Carol Thompson					15129
Carol Wagner					97013
Carol Whitehurst					98403
Carol Wiley					92394
Carol-Ann Dearnaley					1349
Carole Angland	Private citizen	2800 4th Ave N	Great Falls	MT	59401
Carole Hartleb					32744
Carole Jackson					
Carole Pappas					48439
carole pooler					60625
Carole Richmond					98502-442
Carole Smudin					2324
Caroline Hair					29229
Caroline Krewson					94611
Caroline Miller					33710
Caroline Mislove					11238
Caroline Satterfield					45693
Caroline Sévilla					77420
carolkrusk					
Carolyn Barrett					08638/2613
Carolyn Boor					91730
Carolyn Clark Pierson					13846
Carolyn Dreeszen					55424
Carolyn Hand					94595
Carolyn Knoll					94563
carolyn massey					62301
Carolyn Pearson					E46SG
Carolyn Radosta					60047

Name of Sender	Organization	Street Number and Name	City	State	Zip
Carolyn Ricketts					21037
Carolyn Riddle					78758
Carolyn Semiglasow					
Carolyn Spier					95736
Carolyn Stallard					95073
carolyn suchenicz					6076
Carolyn Villanova					1201
Carolynne Cullerton					60098
Carrie Breen					6840
Carrie Chaffin					86403
Carrie Cole					
Carrie Darling					
Carrie Swank					19608
Carrie West					47303
Casey Jo Remy					97429
Casey Walsh	Simms Fishing Products		Bozeman	MT	
Cashin Hunt					27103
Catherine Clifton					13809
Catherine Farrell					2474
Catherine Harrison					55305
catherine lowry					20910
Catherine Macan					95501
Catherine McNamara					32828
Catherine Milovina					95449
Catherine Nelson					34135
Catherine Nettesheim					11743
Catherine Ross					98026
Catherine Williams					85719
Cathryn Wolf					44240
Cathy Brownlee					72450
Cathy Gianikos					46151
Cathy Marczyk					10930
Cathy Ream					59825
Cathy Rowan					10462
Cathy Ruperti					7010
Cathy Sikes					77450
Cathy Staniunas					01532
Cay White					80260
Cayley Stoker					90265
Cecile Yvonne Aeschlimann					9565
Cecilia Moller					44338
cecilia SEABROOK					60403
Cecleia Samp					60176
Celeste Andersen					93463
Celeste Howard					97124
cem ozkok					21032
Chad Fuqua					77080
chad plumly					30328
Chantal Buslot					35100
Chantal Cumming					CF3 1TE
Charlene Ferguson					50569
Charlene Kerchevall					92054
Charlene Rush					15101
Charles Alexander					21093
Charles and Gerry Jennings		317 Fox Drive	Great Falls	MT	59404
Charles Brumleve					66502
Charles Card					1950
Charles Daugherty					47304
Charles Fitze					55709
Charles Hughes					71923
Charles Ogle					18058
Charles Phillips					65233
Charles Wolfe					91342
Charlie Donnes					59101
Charlotte Alexandre					80229
Charlotte McCue			Cody	WY	
Cheri Michalak					92026
Cheri Moore					34287
Cherine Bauer					97404
Cheryl Arthur					22901
Cheryl Biale					98512
Cheryl Owen					32656
Cheryl Shushan					2478
Cheryl Williams					60543
Cheryl Young					75212
chet mohr					77345
Chey Richmond					32503
Chiara Canalini					65027
Chris Andersen					
Chris Bouckaert					91360

Name of Sender	Organization	Street Number and Name	City	State	Zip
Chris Casper					54481
Chris Frost					8807
Chris Kubiak					18626
Chris Lish					
Chris Lyon					21774
Chris Manley					12345
Chris Phelps		403 Mining Pl.	Helena	MT	59601
Chris Policastro					
Chris Roberts					76182
Chris Scholl					07753
Chris Schustrom	Trout Unlimited				
Chris Stiff					23188
Chris Tall					59702
Chris Watson					37931
Chris Worcester					96160
Chris Wrinn					6460
christa link					99206
Christa Neuber					90069
christa romppanen					85362
Christiane Strobl					01090
Christie Turano					93942
Christina Babst					90069
Christina Moodie					85704
Christina Raptis					11725
christina savinos					10558
Christina Viljoen					35210
Christine Hayes					
CHRISTINE HERBERT					22101
Christine Josselin					33930
Christine Lojko					01801
Christine Nicholson					B23 5US
Christine Payden-Travers					
Christine Rosen					94720
Christine Sandow					30728
Christine Stewart					92026
Christine V Fink					95207
Christne Eardley					37075
christopher Burson					33312
CHRISTOPHER DANNE					32608
Christopher Dowling					79843
Christopher Ecker					20850
Christopher Orman.		48 11th Avenue	Helena	Montana	
Christopher Panayi					10007
Christopher Stuart Harrison					4157
Christopher Tobias					15241
Christy Bulskov					92024
Christy Erwin					64424
Christy Molenkamp					92054
Chuck Donegan					10704
Chuck Frey		221 Glenwood Ct	Great Falls	MT	59405
Cindy Bassham					75080
Cindy Blue					60062
Cindy Carper					25276
Cindy Lance					96822
Cindy Meyers					9510
cjurczewski					
Claire Chambers					92563
Claire Joaquin					95726
Claire Perricelli					95501
Clara Gajdosova					794 01
Clarence Bolin					83702
Claude Robert					
Claudia Adamson					72703
claudia fischer					35629
Claudia Van Gerven					80305
Claudia Wornum					94605
claudio niedworok					27505
Clay Brantley					75071
Cleavert Guyton,					29105
Cleo Slifer					97019
Cliff Johnson					94019
Clotilda G. Devlin					07924
Colin Cooney					
Colin Cooney	Trout Unlimited				
Colin V Jenkins Colin Jenkins					0
Colleen Cleary					46203
Connie Curtis					80205
connie curtis					78758
Connie Dunn					38256
Connie Grogan					80105

Name of Sender	Organization	Street Number and Name	City	State	Zip
Connie Hodges					75063
Connie Mangas		8383 Forswall Road	Belgrade	MT	59714
Connor Hansell					
Connor Hansell					84121
Corby Design					
Corey Schade					7711
Cori Bishop					08215
Corine Cathala					
Corrina Parker					04650
Cortney Zaret					60657
Cosette Freeman					97203
courtney stefano					10805
Craig Figtree					60614
craig kleber					19607
Craig O'Connor					19090
Crickett Miller					63117
Cristina Novelo					91698
Cristina Rio Lopez					ES15590
Cristina Sherer					43334
Cristina Tirelli					42123
Cristina Wenzl					98087
Cristine Bhaiji					44145
CT Bross					94597
Curtis Helvey		3180 Baxendale			59601
Curtis Thompson					
Cy Williams					
Cyndi Clough					67207
Cynthia Betts					53142
Cynthia Brooks-Fetty					67861
cynthia brown					31093
Cynthia Chrystal					97702
Cynthia Miller					95632
Cynthia Small					80401
D Ashurst					96021
D Bello					20009
D Cohen					1748
D Fassman					11590
D Garratt					32086
D. Filipelli					
D. Grady					28513
D. Rowe					90403
Dacia Murphy					85295
Daggie Anders					9123
Dale Janssen					60491
dale riehart					94107
Dale Shero					32034
Dale Sloat					7843
Dameta Robinson					54494
Damian Velez					8859
Dan Crockett		7015 Siesta Drive	Missoula	MT	59802
Dan McCurdy					62791
Dan Morgan					93560
Dan Vermillion		44 Deer Creek Road	Livingston	MT	
Dana Bordegaray					93430
Dana Monroe					92104
Dana Rockwell					02816
Dana Sklar					8034
dancing.creek					
Daniel and Karen Erlander					
Daniel Gonzales					93536
daniel pearce					15658
Daniel Rebson					77005
Daniel Roberts					63123
Daniel Salmen					15205
Daniel Wilkinson					90808
Daniela Bosenius					50226
Daniela Rossi					83210
Danielle Graham					48193
Danielle L'Ecuyer					K1N 1C4
d'Anne MacNeil					85202
Dany Lindenbacher					6877
Darik Corzine		264 Warm Springs Creek Rd	Clancy	Montana	
Darlene Jakusz					54407
Darrell Schmidt					67133
Darren Frale					90065
Daryl Rice					18944
Daryl Sparks					85068
Dave & Ada Dorn					94551
Dave Delson					33487
Dave Galt					

Name of Sender	Organization	Street Number and Name	City	State	Zip
Dave Karrmann					32233
Dave Mills					78644
Dave Ogilvie					93105
Dave Perkins			Wolf Creek	MT	
Dave Searles					53520
Dave Willis					97520
david					
David Addison					22205
David Austin Nix					
David Bonnell					75234
David Brayfield					61821
David Brooks					
David Brooks	Trout Unlimited				
David Carey-Kearney					32082
David Chastain					30577
David Chouinard	Chouinard Outdoor Associates				
David Clifford					01516
David Copper					24401
David Crawford					40207
David Daniels-Lee					98569
David Elwell					20011
David Fiedler					19020
David Fisher					
David Friend					80015
David Fura					94577
David Grainger					
David Grant					97504
David Halsall					
David Henning					
David Inouye					81419
David J Saylor			Washington	DC	
David J. Lafond					
David J. Murnion		1333 Ancient Tr	Forest Grove	MT	59441
David Kagan					17740
David Kanter					
David Keddell					
David King					10002
David Klass					10011
David Klinke					10901
David Koppel					75228
David LaVerne					18519
David Ledermann					17070
David McNiff					22015
David Meade					15613
David Mitchell					80218
David Nelson					85715
David Nikonow		12 Orchard Court	Missoula	MT	59803
David Perkins	Orvis Company				
David Perkins					81040
David Powell					11385
david Prystal					12404
David Randall					11777
David Ringle					18062
David Smallwood					
David Smith					93065
David Snope					7830
David Soares					95726
David Stanley					61822
David Stetler					98034
David Urich					33901
David Walsh					55104
David Watson					95446
David Wilsey	Trout Unlimited		Great Falls	MT	
Dawn Albanese					60007
Dawn Hendry					80127
Dawn Mason					17901
dawn Pesicka					57106
Dayanara Montes De Oca					85142
DC Katten					85331
Dean Amel					22201
Dean Mindock					62234
dean peter					55372
Dean Pryer					97402
Dean Stevens					2467
Deb Fritzler					24521
Deb Staudt					45363
Debbie Jensen					85379
Debbie McCarthy					04966
Debbie Reichow					85260
Debbie Sequichie-Kerchee					73527

Name of Sender	Organization	Street Number and Name	City	State	Zip
Debbie Thorn					98033
Debi Combs					30033
Debora Johannsen					50823
Deborah					
Deborah Cheek					61054
Deborah Cheek					61054
Deborah Childers					95350
Deborah Coble					13088
Deborah Fuller					55108
Deborah J Cruz					98248
Deborah Kreuser					80235
Deborah Lipman					02906
Deborah Partington					85064
Deborah Spencer					01821
Debra Boswell					99224
Debra Culwell					97030
Debra Diegoli					05156
Debra Evon					55403
DEBRA heatherly					60047
Debra Miller					7823
Debra Shepler					17103
Dechenne Cecil					
Dee Stover					27262
Deke Gliem					50066
Delaine Spilsbury					89318
Delores Stachura					62948
Demetrios Lekkas					14563
demian gregg					32084
Denie English					
Denise Bivona					7882
Denise Brown					27316
Denise Castiglia					76708
Denise Gonzalez					44601
Denise Halbe					95476
Denise Hayes					93001
Denise Hosta					49408
Denise Kobylarz					07440
Denise Lenardson					91040
Denise Malcher					77060
Denise Shapiro					
Denise Turner					95965
Dennis & Susan Kepner					
Dennis B. Concannon	Private citizen/Trout Unlimited/Former CO State Health Chemist	1604 Powers Boulevard	Belgrade	MT	59714
Dennis Concannon			Belgrade	MT	
Dennis Costanzo					60630
Dennis Feichtinger					48183
Dennis Kreiner					60110
Dennis Ledden					95656
Dennis Tighe		717 13th St. SW	Great Falls	MT	59404
Derek Gendvil LV Derek Gendvil					89117
Derf Johnson	Montana Environmental Information Center	P.O. Box 1184	Helena	MT	59624
Derf Johnson	Montana Environmental Information Center				
Desiree Nagyfy					99006
Dessa Dale		10387 Miller Creek Road	Missoula	MT	59803
Devon Seltzer					27410
Diana Baumgartner					63011
Diana Gebczyk					14304
Diana Moore					76513
Diana Smith					22209
Diana Sommerville					13337
Diana Ward					33713
Diane Basile					11746
Diane Black					97317
Diane Clark					24185
Diane Corrigan					48316
Diane Fisher					
Diane Garetz					55343
Diane Granahan					77059
Diane Hendricks					76374
Diane Knight					91307
Diane Kokowski					15216
Diane Kuc					17011
Diane Marks					98362
Diane Norris					60631
Diane Nowak					86326
Diane Pease					03561
Diane Rohn					22101
Diane Schwarz					20785
Diane Tessari					55331

Name of Sender	Organization	Street Number and Name	City	State	Zip
Diane West					02762
Dianne Miller					92103
Dick Gray					81401
Diego Pedraza Lahoz					5369
Dina Belmir					33179
Dineo Maine					91915
dineslee					
Dirrk Rogers					76301
Dita Škali?					9226
Dixie Patterson					93442
dkjdpm					
Dodie Sweeney					79830
Dollie Moir					85546
Dominic Giles					IP22 4NN
Dominic Macchiagodena					H1M 3K5
Dominique Lang					84110
Dominique RENUCCI					75019
Don & Deb Smith					37130
Don Barth					23005
Don Crozier					63366
Don E. Dumond					97403
Don McKelvey					44123
Don Smith					5819
Don Thompson					2139
Dona LaSchiava					85741
Donald Barker					27949
DONALD BARRETT					93901
Donald Harland					28715
Donald Heyden					76118
Donald Mackey					64151
Donald Sage Mackay					91031
Donald Shaw					33703
Donald Smith					32905
Donald Taylor					95628
Donlon McGovern					97211
Donna D Varcoe					16803
Donna Davis					73071
Donna Heikkinen		PO Box 3293	Butte	MT	59702-
Donna Knipp					10034
donna mccollum					45056
Donna Pitt					24128
Donna Smith					19083
Donna Thelander					97211
Donna Twoomey					60563
Doretta Miller					33755
Dorian May					95490
Dorian May					95490
Dorie Green					59718
Dorie Reisenweber					
dorinda kelley					97213
Dorothea Stephan					94577
Dorothea Vecchiotti					3444
Dorothy Anderson					2191
Dorothy Brooks					76013
Dorothy Davies					94114
Dorothy Holtzman					15009
Dorothy Kethler					87557
Dorothy Maxwell					10913
Dorothy Parkel					30306
Dorothy Winick					33019
dostana ljusic					10990
Doug Bender					90277
doug krause					58102
Douglas Kinney					13825
Douglas Mccormick					92679
Douglas Meyer					6437
Douglas Wentworth Campbell					
Douglass Krueger					
Doyle Adkins					76028
Dr Fred and Mrs Patricia Montague					84017
Dr Mike Adamson					80501
Dr Stefan Petersen					25813
Dr. Virginia Jones					49004
Dr. William and Nancy Butler (geologist)					80437
Dr. William 'Skip' Dykoski					55112
Drew Blewett		219 3rd Ave. North	Great Falls	MT	59401
Drew Cucuzza					6515
drichey1					
Dusty Vinson					63090

Name of Sender	Organization	Street Number and Name	City	State	Zip
Dwight & Ann Ericsson					46750
Dyan Draper					19344
Dyan Gibson					39564
Dylan Flather					90803
E A Hickok					
E Cotton					
e p					95481
E. Blaine Converse					23063
Echo Mitchell					55406
Ed and Jan Jang					V8k1c9
Ed Fiedler					78758
Ed Loosli					
Ed Rowell					32696
Ed Parks					73505
Eden Guidroz					K0J1B0
Edie Bruce					94530
edna gruvman					11746
Edward and Gail Temple					11215
Edward Day					32829
Edward Freeman					19139
Edward Justin Lee					00000
Edward Kern					78253
Edward Macan					95501
Edward Rengers					12498
Edward Woll					2138
Edwin Quigley					35661
eileen juric					27605
Eileen Mohr					44240
Eileen Reznicek					60187
Elaine Donovan					14466
Elaine Eudy					30344
Elaine Johnson					30228
Elaine Livesey-Fassel					90064
Elaine Siebenaler					10954
Elaine Sperbeck					13365
Eldert Koenderman					3461GR
Eleanor Anderson-Miles					94804
Eleanor Dowson					98012
Elena Busani					10463
Eliah Perona					90291
Elisa Dickon					23509
Elisabeth Bechmann					0
Elisabeth Bersin					90403
Elisabeth N.					60617
Elisabeth Price					87110
Elisabeth Ritter					91126
Elisabeth Talis					1002
elisabetta tamiazzo					20432
Elise Adibi					15217
Elise McCoubrie					
Elise Phillips Margulis					07039
Elisheva Karo					89128
Eliza Woodworth					
ELIZABETH ANN HARRIS					53213
Elizabeth Bonaventura					11211
Elizabeth Butler					42420
Elizabeth Cliff					80504
Elizabeth Conlan					4740
Elizabeth Dahmus					22902
Elizabeth Davidson					92320
Elizabeth Enright					85251
Elizabeth Hemzacek					60527
Elizabeth Joseph					02911
Elizabeth MacKelvie					54915
Elizabeth McCullough					J0J1C0
Elizabeth McDonald					81623
Elizabeth Milliken					94574
Elizabeth Nedeff					98058
Elizabeth Rotter					94117
Elizabeth Schaeffer					03833
ELIZABETH SIERRA					89107
Elizabeth Struthers Malbon					24060
Elizabeth Tuminski					06907
Elizabeth Ungar					10025
Elizabeth Waldron					97330
Elizabeth Watts					11563
Elizabeth Werner					6514
Elke Hoppenbrouwers					6512
Ellaine Janicki					
Elle VanderSchuur					3217

Name of Sender	Organization	Street Number and Name	City	State	Zip
Ellen DeMarco					54937
Ellen Dryer					45140
Ellen Fallon					27510
Ellen Halbert					20630
Ellen McCann					92027
Ellen McNeirney					20814
Ellen North					92677
Ellen Phillips					94704
Elliot Mason					78752
Elliott Woods		306 S 11th Ln	Livingston	MT	59047
Elmer A. Fugman, Jr.					60645
Eloy Santos					28023
Els denHoed					3233 CV
Ema Camara					1070-133
Emily Bovee					48309
Emily Haggerty					48823
Emily Onello					55812
Emily Rothman					87110
Emily Rugel					20016
Emily Sagovac					33414
Emily van Alyne					99353
Emily Willoughby					98188
Emma Henderson					0
Emma Jennings					77502
Erasmo Joseph					03001
Eric Beck					37923
Eric Bloomgren					
Eric Burr					98833
Eric Fosburgh					98112
Eric Granrud		7116 Island Road	Jarreau	LA	70749
Eric Hermann	Poudre Paddlers Club		Fort Collins	Colorado	
Eric Lane		612 N 11th	Livingston	MT	59047
Eric Lemberg					98117
Eric Meyer					52556
Eric Moore					85718
Eric Robson					53705
Erica Johanson					08525
Erik LaRue					98233
Erik Schnabel					94134
Erika Agnew					28806
Erika frey					33131
Erika Wanenmacher					87505
Erika Winkelhake					80304
Erina Calder					44022
Erma Lewis					11204
Erna Beerheide					80206
Ernest Cooper					46203
Ernie Looney					91380
Ernie Walters					94587
Espree Bonterre					97239
Esther Garvett					33186
Esther Salem					45750
Ethan Decaprio					80219
Eugene Falik					11691
Eugene Gorrin					7083
Eugene Howard					37064
Eugene Jones					84105
eusebio manuel vestias					20316
Eva Dayan					90036
Eva van Mieghem					
Eva Yus					08001
Evan Jane Kriss					94965
Evan Youngblood					
Eve Saglietto					86754
Evelyn Coltman					28786
Evelyn Griffin					82523
Evelyn Parker					
Evelyn Verrill					86305
Evgeniy Kashkarov					
Ewa Czyzewska					02591
Ewa Piasecka					1562
F H					98366
F. Robert Wesley					14850
Fabienne Oubrayrie					6100
faith kirk					20850
Fatima Al-Hayani					43615
Faye Bergan		619 1st Street	Helena	MT	59601
Faye Pineda					52402
Felicia Dale					98271
Felicia Williams					20016

Name of Sender	Organization	Street Number and Name	City	State	Zip
Ferne Clements					44111
Fjaere Nilssen-Mooney					91606
Floyd Grant					74014
Forest Frasieur					94510
Fran Ransom					8701
fran teresi					44231
Franca Marchese					20125
Frances Bell					55104
Frances Blythe					95620
Frances Crocco					8822
Frances Rove					66206
Francine Larstein					95076
Francine Ungaro					6489
Francis Mastri					6516
Francis Slider					
Francisco Dacosta					8046
Francois Bezuidenhout					33131
Françoise Bolot					69200
Françoise SANNIER					77710
Frank Baker					
frank belcastro					52001
Frank Matalone					30345
Frank Pilholski					01701
Frank Sennett					59457
Frank Wilsey					21215
Frankie Seymour					2620
frankrsennett					
Franziska Hanke					95336
Fred Binder					85382
Fred Coppotelli					34209
Fred Jakobcic					49855
Fred Kozak					34465
Fred Madden					14850
Fred Shellenberg		221 S 10th	Livingston	MT	59047
Fred Shellenberg					
frédéric pulcini					34110
Frederick Hamilton					91739
frederique joly					90291
Frederique Petit					94190
fritzi redgrave					85603
G.G. Johnson					20009
Gabriel Bobek					10012
gabriele holland					3884
Gabriella Steele					32608
Gabriella Turek					91106
Gail and John Richardson					59715
Gail Blumberg					95060
Gail Burns					11735
Gail Gettler			Bozeman	MT	
Gail Lengel					98221
Gail Musante					13754
Gail Noon		20 Robert Lane	Ringgold	GA	30736
Gail Padalino					12196
Gail Roberts					91980
Gail Staples					2747
Gail Weston-Roberts					1760
Gail Yborra					19801
Gaile Carr					96067
Gale Espinosa					85023
Gale Rullmann					27596
gardners3					
Garold Lazaroski		5448 Hwy 83N	Seeley Lake	MT	
Garrett Long			Bozeman	MT	
Garrett Long					
Garrett Munson					
Garry Gleckel					1431
Garry Taroli					18711
Gary Albright					98296
gary baxel					92234
Gary Dowling					94947
Gary Glynn		202 Westview	Missoula	MT	59803
Gary Goetz					85377
Gary Grice					60647
Gary Herwig					21286
gary jarvis					49249
gary kuhn					24014
Gary LaClair					48033
Gary Lofgren					60525
Gary Rejsek					60440
Gary Wrasse					80906

Name of Sender	Organization	Street Number and Name	City	State	Zip
Gavin Bornholtz					48439
Gavin Dillard					28711
Gayle B. Rosenberry					21218
Gene and Dori Peters					85351
Gene Gudmundson			White Sulphur Springs	MT	
Gene Moy					
Geoff Regalado					91503
Geoffrey Pruitt					
George Bourlotos					7950
George Burnash					95670
George Casner					85023
George Casner					
George Craciun					33592
George Erceg					15065
George F. Klipfel II, CLS					92234
George Fairfax MD					98277
George Ferrell					90402
george gavaras					7764
George Grace					90027
George Kirkwood			White Sulphur Springs	MT	
George Kormendi					10033
George Levesque					1851
George Livingston					
George Loveday					95949
George Plummer					19335
Georgia Carver					95670
Georgia Labey					91942
Georgia Libbares					60611
Georgia Locker					80525
Georgina Wright					89032
Gerald Brookman					99611
Gerald Hallead					11373
Gerald Morris					92129
Gerald Walsh					10509
Geraldine Crapuche					78960
Gerard Gardner					LA1 3HT
Gerda Brasser					1561AE
gerrit woudstra					91126
Gerry Martin					98466
Gerry Milliken					86326
Gertrude Crowley					02536
GF Wade					37341
Ghislaine Galtier					38300
Gibson Reynolds					08107
Gigi Middlebrook					20850
Gilay Oliveira Souza de Azevedo					28300-000
Gilda Carrington					10021
Gillian Wilkerson					94941
Gina Bilwin					97708
Gina Caracci					32926
Gina Paige					23060
Gina Pantier					98003
Gina Stiff					23188
Ginger Hipszky					80919
ginger.ikeda					
Ginny Jackson					50014
Giorgio Rolfini					44123
Giovanna Perini-Folesani					61029
Gisela Forster					86368
Gisela Overbeck					00215
Gisele Souza					9876
Glen Anderson					98503
Glenn Koehrsen					
Glenn Ross					95503
Gloria J Howard					85653
Gloria Uribe					8028
Gordon Grant					60614
Gordon MacAlpine					80517
Gordon Whirry		1912 4TH Ave N	Great Falls	MT	59401
Grace Golata					53215
Grace Padelford					98034
Grace Strong					49938
Grant Sorrell					NN7 1ED
Greg Collins					49404
Greg Everett					54521
Greg Flejtuch					94901
Greg Munther		1295 Lena Lane	Missoula	MT	59804
Greg Noose					
Greg Zyzanski					44124
Gregg Menge	Americas Bentonite Corporation	221 Promise Lane	Lewiston	MT	59457

Name of Sender	Organization	Street Number and Name	City	State	Zip
Gregory Coyle					94114
Gregory Duncan					46804
Gregory Fite					94541
Gregory McCue			Cody	WY	
Gregory Whynott					3867
Gretchen Rupp					
Gudrun Dennis					32653
Gudy Terenzio					
Guri Henning					00213
Gustavo Gomes					22819
Guy Alsentzer	Upper Missouri Waterkeeper	24 S. Wilson Ave, ste 6-7	Bozeman	MT	59715
Guy Corvers					15047
gwen irish					1701
Gwen Jennier					22306
Gwendolyn Bye Schulman					19072
H. Asumen					96707
Hal Harper					
Hallie Rugheimer		678 Flathead Creek Rd (Hwy 86)	Wilsall	MT	59086
Hamish Rickett		40 E. Granite St. Apt 2G	Butte	MT	59701
Hannah Jean Nikonow	Board Members of Montana Backcountry Hunters & Anglers	12 Orchard Court	Missoula	MT	59803
Hannah Lange					53572
Hannahlore Trickett					04957
Harold Robinson					35160
Harold Watson					
Harriet Grose					07960
Harriet McCleary					55404
harry knapp					92507
Harvey Nyberg		609 W Evelyn Street	Lewiston	MT	59457
Heath Post					48906
Heather Cross					11222
Heather Little					E5K 3K1
Heather Ruckman					26070
Hector Plascencia					82100
Hedda Haning					25302
Heide Coppotelli					28718
Heidi Hartmann					74193
Heidi Johnson					20902
Helen Bailey					75070
Helen Faller					87529
Helen Hanna					95864
Helen Hays					97045
Helen Jenkins					60030
Helen Jones					97520
Helen McDaid					
Helen Stuehler					89508
Helen Syen					
Helena Wilcox					95204
Henk-J Land					1503 HE
Henriette Matthijssen					T0A 0M0
Henry Berkowitz					16943
Henry Newhouse					4554
Henry Pinard			Colorado Springs	CO	
Henry Sak					T6X 1T1
Henry Schlinger					91201
Henry Weinberg					93110
Herb Townsend					
Herbert C. ZIEGLER					92399
Herbert Elwell					16929
Herbert Sein					10992
Hilary Ransdell	Missouri River Citizens Inc	615 Third Ave North	Great Falls	MT	59401
Hilary Ransdell-Lewin	Missouri River Citizens Inc	615 Third Ave North	Great Falls	MT	59401
Hillary Tiefer					97219
Hiroe Watanabe					75211
Hollie Hollon					32806
Holly Burgin					91405
Holly Dowling					59101
Holly Kukkonen					52240
Holly Quick					37204
Holly Quinn					95521
hope roberts					95019
horace smith					78750
Howard Clark					98359
Howard Cohen					94306
Howard Petlack					33414
Howard Young					2210
Hugh Havlik					33952
Hugh Phillips					85282
Hugh Zackheim		315 Ming Place	Helena	MT	59601
Hunter Klapperich					54768

Name of Sender	Organization	Street Number and Name	City	State	Zip
I. Fogg					04927
Ilda Johnston					01603
Ilene Kazak					48116
Ineke Jansen-Alblas					4421HX
Ira Weissman					13676
Irena Franchi					33160
Irene Radke					33312
Irina Lamadrid					07600
Isabel Cervera					28147
Isabel Ortiz					97003
Isabel Sena					11372
Isabella Cooper					20740
isabelle boisgard					86000
Isabelle Zomer					9649
Issaqueena Sparks					3111
Iva Klimankova					78701
J Beverly					61801
J Bocchino					10310
J Cairna					
J Cairna					
J Esposito					89431
j h					98363
J Niblack					80132
J O					242
J Stufflebeam					97045
J Weir					
J. Cuci					
J. F. Forests					
J. Mednis					92014
J. Michael Mike" Henderson "					93405
j. stanfield					
J.P. Sherman					3777
J.T. Smith					18960
Jace Mande					89102
Jack gregg					32084
Jack Harris					33710
Jack Stansfield					98292
Jackie Demarais					76049
Jackie Tryggeseth					53951
Jackie Wolf					98261
jacob chachkes					06840
Jacob Johnson					33547
Jacqueline Campbell					70895
Jacqueline Mercenier		1333 Ancient Tr	Forest Grove	MT	59441
jacqueline tessman					49022
Jacqui Lipschitz					14620
Jacqui Skill					96761
jade gregg					95062
Jaen Lawrence					77024
Jake Schwartz					
James Adams					25428
James Carrell					
James Clark					0
James Conway					55901
James Cooper					43023
James Cronin					
James Dawson					95618
James E. McCollum		2828 Central Avenue West	Great Falls	MT	59404
James Flanagan					78602
James Gilmore					97227
James Gladysz					32136
James Hansler					44141
James Hartley					22207
james jackson					80421
James K Hadcroft					
James McBride					16148
James Miller					32503
James Monroe					94521
James Mulcare					99403
James Pilewski					44095
James Ployhar		20 Eden Acres Lane	Great Falls	MT	59405
James Provenzano					90049
James Rice					77520
James Robertson					
James Stevens					98272
James Thoman					37076
James Thomas					27514
James Vander Poel					1532
James Wolcott					47150
JAMES ZITIS					34692

Name of Sender	Organization	Street Number and Name	City	State	Zip
Jamie Caya					98664
Jamie Green					93004
Jamie Guy-Ostrowski					48135
Jamie Harrison					33418
Jamie Le					94501
Jamie Louis					96782
Jamie Shultz					26508
Jamie Thomas					32068
Jamila Garrecht					94952
Jan Ackerman					55124
Jan Beauchamp					88240
Jan Boudart					
Jan Clare					L5H 3Y5
Jan Donaldson		100 Stuart Street	Helena	MT	59601
Jan Emerson					10032
JAN GOLICK					97405
Jan Repp					91706
Jan Salas					95062
Jan Sloat					7843
Jan Wilson					28801
Jana Austin					86301
Jana Kitzinger					54107
Jana Perinchief					95821
Janae Bailie					86409
Jane Ahrens					94707
Jane and Harold Rudner					33063
Jane Bunin					80305
Jane Clevenger					80537
Jane Engelsiepen					93013
Jane Gulley					38173
Jane Herschlag					06811
Jane Nachazel					90026
Jane Oldfield					
Jane Sawcer					CB22 3TD
Janeene Porcher					80401
Janell Smith					62074
Janet					
Janet Duran					10012
Janet Falcone					40205
Janet Forman					10011
Janet Fotos					3049
Janet Johnston					08050
Janet M Strothman					94708
Janet Matthews					
Janet Romine					50315
Janet Smith					T6H0W9
Janet Walls					89423
Janice Banks					3225
Janice Bernard					10510
Janice Hallman					55110
Janice Holkup					98103
Janice VrMeer					86336
Janie Horowitz					7761
Janie Martinez					77429
JANINE COMRACK					93023
Janis Dairiki					94707
Janis Sawyer					32459
Janis Todd					8550
Jann Johanson					92663
Jared Cornelia					19804
Jared Kloth					2760
Jarrett Cloud					07950
Jason Brininstool					
Jason Chadwick					10549
Jason Moore					97222
Jason Pitt		105 N Warren St	Helena	Montana	
Jason Rhodes					97701
Jason Steadmon					89005
Jason Thomas					96019
Javier Del Valle					
Jay gregg					32084
Jay Jewett		1205 10th Ave N.W.	Great Falls	MT	59404
Jay Melzer			Hamilton	MT	
Jaye Bergen					94303
Jayson O’Neill		14 S Howie	Helena	Montana	
Jean Adams					87110
Jean Cameron					77845
Jean Farris					32806
Jean Goetinck					85746
Jean King					94550

Name of Sender	Organization	Street Number and Name	City	State	Zip
Jean Langford			Huntsville	AL	
Jean Perkins					04562
jean-claude guigot					91330
Jeane Harrison					50321
Jeanne & Vern Long					44145
Jeanne Bergen					12565
Jeanne Musgrove					
Jeanne Schlatter					43812
jeanne Sumner					95454
Jeannette Blank			Livingston	MT	
Jeannie Evans					GL13 9HN
jeaolson					
Jeb Pronto					95736
Jeff Arnett					95060
Jeff Green					60423
Jeff Komisarof					20854
Jeff Tatom					97526
Jeff Welch					
Jeffery Biss					60120
Jeffery Garcia					
Jeffery Morgenthaler					49331
Jeffrey Cohen					01969
Jeffrey Hemenez					94583
jeffrey tabin					33321
Jeffrey Taylor					8223
Jen Perlaki					33139
jen plishka					13090
Jenna Fallaw					
Jennie Sabato					8244
Jennifer Anderson					37207
Jennifer Bellano					19036
Jennifer Cunningham					60506
JENNIFER DELAO					97206
Jennifer Gilbert					60534
Jennifer Gindt					98902
Jennifer Goldman					59715
JENNIFER HANDLIN					85653
Jennifer Harris					3609
Jennifer Holston					28277
Jennifer Kunze					21223
Jennifer Nitz					59758
Jennifer Pittman					98027
Jennifer Reame					
Jennifer Scott					33931
Jennifer Zielinski					17560
jenniferhopplehorn					
Jenny Harbine			Livingston	MT	
Jenny Harbine					
Jens Trulsson					11528
Jer Haelen					10940
Jeremy Spencer					94044
Jeremy Taylor					94533
Jeri Altman					80503
Jeriene Walberg					97701
Jerome Milks					5491
Jerome Schaack					80230
jerome stanley					45056
Jerry and Jeff Ladewig		P 0 Box 1184	Emigrant	Montana	
Jerry Calhoun					85929
Jerry Ladewig					
Jerry Wells			Helena		
Jesse Brunner					
Jesse M. Brown	Hyalite Heavy Industries, Inc.				
Jesse Reyes					07040
Jessica Card					30518
Jessica Cresseveur					47150
Jessica Diekman					76054
Jessica McCutcheon	Trout Unlimited				
Jessica Mitchell					80129
Jessica Murphy					78210
Jessica Rubino		527 Dearborn Ave.	Helena	MT	59601
Jill Alibrandi					6896
Jill Berkowitz-Berliner					10549
Jill Fogg					4107
Jill Kortright					12550
Jill Paulus					60187
Jill Simon					
Jill Wettersten					44074
Jillian Fiedor					59101
JIM ABBONDANTE					34952

Name of Sender	Organization	Street Number and Name	City	State	Zip
Jim and Janice Cooperstein		9716 E. 45th Ave	Spokane Valley	WA	99206
Jim Christiansen					M6G 3Z1
Jim De Camp					98312
Jim Finn					95421
Jim Forbes					60202
jim Gergat					19505
Jim Jenson	Montana Environmental Information Center				
Jim Lansing					
Jim Luebke					54935
Jim Marsden					55109
Jim McCollum					
Jim Mitchell					
Jim Petkiewicz					95125
jim Snee					5736
Jim Stanford			Jackson	Wyoming	
Jim Youssef, MD					
Jimmy Dobes				TN	
JL Charrier					55391
jmmoore					
Jo Ann Kiva					91107
Jo Ann McGreevy					7047
Jo Ann McNaughton-Kade					62401
Jo Dolittle					Ll54 7pt
Jo Garrett					
Jo K					85635
Joan Bailey					97229
Joan Christensen					56649
Joan Ellen McCoy					06825
Joan Farber					10011
Joan Glasser					80301
Joan Hughes					55416
Joan M. Taylor					72659
Joan McGrath					02038
Joan Mitchell					37076
Joan Murphy					81133
Joan Smith					94904
Joan Walker					93514
Joan Walker					32619
Joana Kirchhoff					
Joann Butkus					60632
Joanna Hollis					19610
Joanne Berghold					
Joanne Dirk					44133
JoAnne Edsall					28031
Joanne Fisher					
Joanne Fisher					
JoAnne Larsen					1238
Joanne LaVine					73064
Joanne McGrath					28779
Joanne Sieck					55906
Joanne Skelton					85712
Joanne Snyder					92123
Jocelyn B					2917
Jodi Hanson					60005
Jodi Rodar					1002
Jody Gibson					50315
Jody Goldstein					55903
Joe Buhowsky					94582
Joe E Ojeda jr					95747
Joe Frascone					97338
Joe Phelps		3930 Hwy 89	Livingston	MT	59047
Joe Sowerby					
Joel Franjevic		3472 Snow Goose St.	Helena	MT	59602
JoEllen Rudolph					49770
Johann Hauer					00000
Johanna Lindsay					94539
John A					59639
John and Jean Fleming					55044
John Andes					
John Barnes					
John Bradshaw					28212
John Brewer					45750
John Burridge					02914
John Burt					84020
John Childs		1700 West Koch Street Suite 6	Bozeman	MT	59715
John Clema					
John Cooper					
John Csaszar					19522
John Dalla					89142
John Daly					92672

Name of Sender	Organization	Street Number and Name	City	State	Zip
John Doucette					2908
John Eckler					80226
john gregg					95062
John Hamann					
John Helvey					
John Hill					0
John Hoekstra					12190
John Klinefelter					
John Kowalski	Fly Water Consulting LLC	1107 LeGrande Cannon Blvd	Helena	MT	59601
John Krumrein					4849
John Leonard					15202
John Limbach					53703
John Liss					M5S2m4
John Livingston					96001
John Lynch					1773
John Margerum					19129
john miller					14817
John Moon					31406
John Moszyk					63129
John Nelson					38201
John Ochs					49720
John Oetinger		1500 Sunflower	Missoula	MT	59802
John Reid					37683
John Reiter					75231
John Ruttner					92373
JOHN SEAMON					85741
John Sullivan	Montana Back Country Hunters				
John Tangney					97086
John Weston					53143
John Whitford					77459
John Wiesner					94546
John Wise					85201
Johnnie Prosperie					75946
Johnny Armstrong					71270
Jolene Schalper					
Jon Anderholm					95421
Jon Anderson					80498
Jon Hager					84065
jon hudson					45387
Jon Kapecki					14620
Jon Martell					2891
Jon Moe		1065 Cap Rd	Helena	Montana	
Jon Senour					92109
Jon Siegfus					90650
Jon Singleton					10118
Jonathan Boyne					96822
Jonathan Chu					94539
Jonathan Dirrenberger					94114
Jonathan Rayson					10040
Jonathan Rick					01257
Jonathan Scher					80903
Joni Mulder					
Jordan Briskin					
Jordan Hashemi-Briskin					94306
Jordan Longever					2125
José Leroux					10065
Jose Rosario					33612
Joseph "Alex" Sweeney					
Joseph Dadgari					90049
Joseph Haemmerle					7866
Joseph Johnson					
Joseph Melvin					96003
Joseph Naidnur					61604
Joseph Pluta					93301
Joseph Rodriguez					95121
Joseph Shulman					92115
Joseph Vincent					70058
Josephine Scherer					87107
Josh and Jenny Paddock					
Josh Pelleg					84965
Josh Seckinger					
Josh Wainwright					40056
Joshua Dickinson	The Forest Management Trust	309 North Black Ave	Bozeman	MT	59715
Joshua Dickinson					59715
Joshua Morgan					45103
Joshua Phillips					
josie Ravenwolf					48718
Joy London					6854
Joy Mamoyac					97330
Joy Zadaca					90807

Name of Sender	Organization	Street Number and Name	City	State	Zip
joyce BRITCHER					33324
joyce carlson-leavitt					87107
joyce ciotti					15216
Joyce Good					60625
Joyce Murray					BN3 6NE
Joyce Overton					75088
Joyce Pusel					27713
Joyce Robinson					21061
Joyce Stoffers					85351
Juan Carlos Gracia					E50001
juan martin					20000
Jude Lotz					91505
Judi Gooding					84092
judi kerr					73501
Judi Poulson					56031
Judith A Conoyer					63130
JUDITH BERNHANG					11743
Judith Embry					01247
Judith Fordham					16832
Judith Hance					98115
Judith Lang					22530
Judith Nelson					11209
Judith Reilly					83607
Judith Savard					54541
Judith Smith					94601
Judith Swain					SA9 2AP
Judith Wilson					82201
judy					
Judy Carlson					92660
Judy Childers					53714
Judy Clark					49445
Judy Devault					61607
Judy Jensen					98070
Judy Kaminski					92692
Judy Mason					98008
Judy McKinney					72631
Judy Ress					05052
Judy Rhee					11211
Judy Shively					92101
Judy Ward		P. 0. Box 637	Lolo	MT	59847
Judy Wilcox					97060
juli van brown					70119
Julia Amsler					16214
Julia Cranmer					08088
Julia Gumper					
Julia Martin					84119
Julia Wade					60004
Julia Wright					80829
Julianne Martinson					98201
Julianne Ramaker					
Julie Eva Zimmerman					91423
Julie Griffith					60174
Julie Hansen					57029
Julie Kennie					2670
Julie Knauer					20002
Julie Martin					54837
Julie Riffle					61701
Julie Skelton					48111
Julie Smith					93402
Julie Takatsch					12771
Julieanne Catinchi					00926
Juliet Pearson					96734
June Cattell					29169
June Curley					1824
justin.pistore					
JUSTINE TILLEY					2908
k l					97470
K. Smith					14424
Kaatje Adams					
Kacie Huson					97470
Kader Hastings					81201
Kae Bender					
Kalinke ten Hulzen					6717 SL
Kallyn Krash					10034
Karen and Will Lozow Cleary					47403
Karen Angel					85302
Karen Berger					91020
Karen Bond					33458
Karen Bravo					60068
Karen Brennhofer					56377

Name of Sender	Organization	Street Number and Name	City	State	Zip
Karen Chenoweth					80020
karen chinn					95425
Karen Deckel					02532
Karen Glauber					5753
Karen Goshaney					
Karen Guarino Spanton					19127
Karen Hellwig					90056
Karen Hewelt					48001
Karen Jacques					95811
Karen Kawszan					77379
Karen Keating-Secular					11374
karen kindel					44718
Karen Kirschling					94117
Karen Krause					12205
Karen Kravcov Malcolm					
Karen Landrum					67357
Karen Maguire					1773
Karen Matulina					32080
Karen McMillan					EH14 7ER
Karen Pecsok					65775
Karen Renne					59802
Karen Scotese					60202
Karen Stimson					6477
Karen Swanepoel					8001
Karen West					92780
Kari A Kronborg					
Kari Gunderson					
Karin Kirk			Bozeman	MT	
karin spitfire					4915
Karl Hamann					55066
Karl Koessel					95519
Karl Lohrmann					90245
Karla Everett					98682
Karlene Gunter					14618
Kary Hun					
Kate Dougherty					55811
Kate Gualtieri					19070
Kate Harder					60137
Kate Kenner					5301
Kate Nyne					94601
Kate Skolnick					11238
Katharine Christie					3750
Katharine Molnar					06098
Katharine Odell					53711
Katherin Balles					98310
Katherine Aker					91042
Katherine Farago					10987
Katherine Leahy					94552
Katherine McMahon					
Katherine Nolan					95014
Katherine Rhoda					4041
Katherine Sampson					
Katherine Wiese					93924
Katherine Wojciechowski					13421
Kathi Kibbel					75208
Kathi Ridgway					43110
Kathleen Bradley					55432
Kathleen Brown					31005
Kathleen Eaton					19709
Kathleen Helmer					91307
Kathleen Kuczynski					92630
Kathleen Lee					98503
Kathleen Medina					1240
Kathleen Mireault					2130
Kathleen Moraski					55125
Kathleen OConnell					46227
Kathleen Polosky					15601
Kathleen Wheeler					99006
Kathrin Engels					42857
Kathryn Burns					78727
Kathryn Christian					81501
Kathryn Heniff					46356
Kathryn Johanessen					06906
Kathryn Lemoine					71291
Kathryn Pierce					13203
Kathryn Rose					80205
Kathryn Spence					94556
Kathryn Yearsley					97211
kathrynburn					
Kathy Collins					32092

Name of Sender	Organization	Street Number and Name	City	State	Zip
Kathy Durrum					80017
Kathy Govreau					92256
Kathy Gynane					K9J 2H2
Kathy Hart					08752
Kathy Kearns					11542
kathy kestell					99208
Kathy Mallory					84105
KATHY MOORE					60123
kathy morris					14867
Kathy Motsinger					83704
Kathy Mott					75143
Kathy O'Brien					95560
Kathy Svendsen					97527
Kathy Watson					85712
Kathy Yeomans					93001
Kathy, Mark, Chris & Jessie Groth					80014
Katia Scaglia					37100
Katlyn Moore					33838
Kay Brainerd					48111
Kay Johnson					1470@
Kay Lowe					80233
Kay Randall					56560
Kay Reinfried					17543
Keiko M.					94118
Keith D'Alessandro					48187
Keith Everton					23113
Keith Rick II					34761
Keli Myers					
Kelley Maissen					98229
Kellie Smith					3244
kelly choi					7940
Kelly Conway					4510
Kelly Hageman					85213
Kelly Huffield					
Kelly Lyon					33431
Kelly Schwartz					22201
KELLY WALKER					38401
Kelly Willett					
Ken Bowman					32817
Ken Box					
Ken Decker		209 South B Street	Livingston	MT	59047
Ken Gibb					89448
Ken Goldsmith					27603
Ken Gunther					33478
Ken Knudson					
Ken Moyer					8077
Ken Ross					48103
Ken Wagner					98225
Ken Ward					12078
Ken Wenzer					20707
Ken Zafren					99507
Ken Zontek					98908
Kendall Sanford					6478
Kendra Kaiser					
Kendra Zamzow	CENTER for SCIENCE in PUBLIC PARTICIPATION				
Kenneth Althiser					92223
Kenneth Cochrane					
Kenneth McLean					11422
Kenneth Miller					90290
Kenneth Mullens					87111
Kenneth Nahigian					95827
Kenneth Ruby					03079
Kenneth Winer					83714
Kent Minault					91423
Kerby Miller					65203
Kerry Burkhardt					14094
Kersti Evans					95822
Kerstin Murr					95505
Ketlin Sudarinen					
Kevin Chaput					95816
Kevin Chiu					98115
Kevin Coleman					
Kevin Darcy					98225
Kevin Devine		3015 4th Ave N	Great Falls	MT	59401
Kevin Hurley					33611
Kevin Rolfes					78737
Kevin Schmidt					98110
Kevin Stueven					
Kevin Vaught					37013

Name of Sender	Organization	Street Number and Name	City	State	Zip
Kevin W. McAlister					11710
Kim Beeler					97034
Kim Crawford					30228
Kim Forrest					
Kim Hilt					
Kim Lewis					63628
Kim Limberg					75062
Kim Mcdonald					98271
Kim Mott					83612
kim nero					92627
Kim Sellon					7974
Kimberly Crane					98290
Kimberly Frey					19707
Kimberly Jones					72666
Kimberly Ross					73134
Kimberly Seger					16201
Kimberly Swenson-Zakula					55331
KIMBERLY WELLS					78660
KJ Linarez					
Kris Aaron					80907
Kris Pagenkopf					32607
Krista Dana					94087
krista gorby					07756
Krista Lonsdale					EN4 8UW
Kristeen Keup					
Kristen Howard					21221
Kristen Renton					91354
Kristiina Mod					00690
Kristin Green					49783
Kristin Klass					49106
Kristin VanHorne					13081
Kristina Lamons					77008
Kristina Lozon					48439
Kristine Moy					48230
Kurt Wiggers					
Kyle Haines					97031
Kyle Meakins		211 S C St	Livingston	MT	59047
Kyle W.					98112
Kyle Waller					98374
Kyriaki Matsika					16341
L Panter					33467
L.L. Wilkinson					87571
L.M. Holmes					96817
Lacey Hicks					94587
Lacey Rasmussen					
Lacey Wozny					90027
Laëtitia Petit					77100
Lana Schmitt					
Lanier Hines					96002
Laraine Bowen					L6L 2M2
Laraine Lebron					13502
Larissa Matthews					11735
Larry Bogolub					55105
Larry Hoffman					
Larry Hovekamp					40218
Larry Johnson					37083
Larry Kralj					
Larry McDaniel					52349
Larry McKee					97026
Larry Mitchell		945 Mendocino Drive	Helena	MT	59601
Larry Shatland		144 Little Wolf Rd	Bozeman	MT	59715
Larry Smith					01845
Larry T Caudill					87113
Larry Trochtenberg					63146
Lasha Wells					33707
Laura Anderson					
Laura Andrea Munoz					11121
Laura Chariton					94941
Laura Collins					95670
Laura De la Garza					08195
Laura Fake					19567
Laura Guttridge					32963
Laura Jones-Bedel					92116
laura kaufman					48118
Laura Long					60616
Laura Martinelli					27043
Laura Matturro					11787
Laura Overmann					94010
Laura Ponchick					90036
Laura Ramon					32578

Name of Sender	Organization	Street Number and Name	City	State	Zip
Laura Ray					22312
Laura Riley					95610
Laura Siani					1200
LAURA STEWART					53704
Laura Verpalen					1971 zx
Laura Watchempino					87034
Laura Waterworth					80013
Laura Weiden					98032
Laura Wheeler					49423
laureen picciani					95437
Laurel Brewer					
Laurel Eckert					64116
Laurel Hieb					86005
Laurel Whillock					96740
Lauren Akin					5401
Lauren Lynley					94580
Lauren Murdock					93110
Lauren Potter					
Lauren Thompson					97202
Laurence Margolis					55345
Laurence Topliffe					52556
Laurence Volbart					75012
Laurette Culbert					98107
Laurie King					95123
Lauryn Slotnick					11361
Lawrence Antonich		752 32nd Avenue NE	Great Falls	Montana	
Lawrence Bojarski					6066
Lawrence Crowley					80027
Lawrence Duncan					77406
Lawrence Probes					49685
Lazarus Boutis					85749
Lea Canada					63026
Leah Franqui					19103
LEAH JACOBS					10003
Leanne Yanitski					99501
Leanne Yerby					92614
Lee Bartell					
Lee Margulies					11790
Lee Miller					95212
Lee Robinson					95762
Lee Stroncek		1208 Parkview Trail	Livingston	MT	59047
Lee Whitehall					Ct14 9dq
Lee Winslow					48854
Leigh Sands					21629
Leila Horgan					
Leland Baldwin					90650
Len Wojno					29466
Len Zickler	Fly Fishers International	5237 US Highway 89 South #11	Livingtston	MT	59047
lena maristo					990
Lenie Molendijk-Schipper					5171TG
Lenora R.					
Lenore Reeves					60448
leo uzych					19086
Leona Grage					60191
Leonard Heether					49347
Leonard Tremmel					94115
Leonardo Legorreta					61345
Leontine Hartman					5704 AL
Leotien Parlevliet					9721JZ
Les Roberts					93704
Lesley Blissett					IV54 8LT
Lesley Hudak					94563
Lesley Schultz					94610
Leslie Bradford					73170
Leslie Bullo					48324
Leslie Burpo					97405
Leslie Cassidy					10028
Leslie Cirigliano					84015
leslie danielle brown					84111
Leslie Glass					85653
Leslie Hardyman					34690
Leslie Sutliff					48806
leticia garcia					85252
Lib Smith					29003
Libby Haycock					1464
Lilian Fiorini					44601
Lilithe Magdalene					95461
Lilli Ross					10024
Lillian Wade					37743
Lilly Knuth					11530

Name of Sender	Organization	Street Number and Name	City	State	Zip
Lily Kazantzi					18537
Linc Conard					90210
Linda Anderson					46062
Linda Bridges					62613
Linda Buckingham					82604
Linda Chase					80220
Linda Cottle					3996
Linda Ferland					3743
Linda Freeman					95991
Linda H					44805
Linda Healow			Billings	MT	
Linda Hendrix					97702
Linda Howie					91355
Linda Johnson					46072
Linda Jones					86325
Linda Kane					85208
Linda Kennedy					60304
Linda Kobler					76209
Linda Larkin					95060
Linda Lemmer					80121
linda martens					32409
Linda Martin					12144
Linda McCrosky					28786
Linda McDougal					23011
Linda McKillip					8081
Linda Melski					54449
Linda Messatzzia					18966
Linda Mulder					48167
Linda Nicholes					92807
Linda Pachter					11557
Linda Ross					38117
Linda Sperber					55345
Linda Stuart					32259
Linda Szymoniak					46375
Linda Townill					60544
Linda Veiga					2360
linda williams					8210
Lindsay Champ					15228
Lindsey Caudill					78749
Line Ringgaard Line Ringgaard					07400
Lis Farrell					00100
Lisa Ann Kelly & Family					93101
Lisa Annecone					95407
Lisa Buehler					59922
Lisa Dahill					
Lisa Duke					76012
Lisa Dunphy					02339
Lisa Howell					1520
Lisa Hughes					77550
Lisa Klein					75218
Lisa Koehl					
Lisa Krausz					94920
Lisa Lester					15904
Lisa Montanus					12498
Lisa Patton					94115
Lisa Pisano					11214
Lisa Stevenson					83702
Lisa Stone					77096
Lisa Valiente					60440
Lisa Watson					15122
Lisa Weil					2476
Lisa-May Reynolds					29907
Lisha Doucet					80549
Livia Vertova					10023
Liz Erpelding-Garratt					32086
Liz Taft					
Liza Jordaan					1449
llamrtment					
Lloyd Hedger					98403
Logan Paul					55408
Logan Welde					19122
LOIS HAMILTON					78154
lois lommel					23235
Lois White					97527
Lollie Ragana					90405
Lon Herman					48220
Lonna Richmond					94965
Lopamudra Mohanty					
Lora Leland					4104
Lora Smith					13624

Name of Sender	Organization	Street Number and Name	City	State	Zip
Lora Zeis					77006
Lorelei Stierlen					75075
Lorenz Steininger					22554
Loretta Aja					8034
Loretta Herger					85351
Loretta Larkin					07304
Lori Mulvey					49321
Lorna Anderson	Trout Unlimited				
Lorna Emdy					83333
Lorne Beatty					48114
Lorraine Brabham					07030
Lorraine Dumas					40511
lorraine foster					97202
lothar krikowski					77975
Lou Orr					98155
Louis Levi					17403
Louise Mann					23803
Louise Quigley					2184
Louise Stark					85007
Louise Zimmer					92592
Luanne Mierow					97004
Lucinda Tucker					8619
Luiz Malcher					77060
Luke Barnes					
Lumina Greenway					2879
Lydia Benade					01459
Lydia Peters					30124
Lyle Brandt					55359
lyn capurro					11021
Lynda Addington					59602
Lynda Haemig					55432
Lynda Mattison					
Lynda Nesbitt					85172
Lynda West					22044
lynda.kh.barry					
Lynette Elliott					75252
Lynn Bagli					
Lynn Baily					80233
Lynn Barron					60616
Lynn Bengston					1007
Lynn Cardiff					97301
Lynn Costa					2889
Lynn Fischer					33161
Lynn Glesne					56354
Lynn Ingemi					8807
Lynn McDaniel					30236
Lynn Terrill					75062
Lynn Walker					44110
Lynn Wilbur					99835
Lynne Preston					94107
Lynne Weborg					53704
Lynne Weiske					90048
M C Kubiak					61701
M Langelan					20815
M S					95971
M. Cecilia Correia					07208
M.A. Steinberger					91042
Madria Everson					
Mafalda Afonso					8014
Mafalda Castro					41503
Magally Muedas Munive					13007
Magaly Léger					83440
Maggie Curati					EN5 5HD
Maggie Schafer					80301
Maiara Caroline Telles Gorris					10007
Makenna Connolly					32828
Malcom Gilbert					
Malcom Moore					96122
Manfred Zanger					12776
Manmeet toor					90024
Marc Conrad					60613
Marc Leon					97005
Marc Lionetti					78745
Marc Silverman					90068
Marcelo Vazquez					67000
marcia bailey					28714
marcia bailey					28714
Marcia Bailey					34698
marcia Flannery					94609
Marcia Hoodwin					34238

Name of Sender	Organization	Street Number and Name	City	State	Zip
Marcia Kellam					87507
marcia states					14810
marcieatkinson					
Marck Parlett	Fresh Tracks Educational Consulting				
Marco A. Vasquez-Chong					95050
Marco D'Agostini					188
Marco de la Rosa					
Marcus Intinarelli					99025
Maren Kentfield					85748
Margaret Brown					63348
Margaret Cathey					85297
Margaret Crane					78209
margaret evans					S6 4WE
Margaret Franklin					38017
Margaret Guilfoy					63122
Margaret Herten					44135
Margaret Murray					94564
Margaret Rangnow					
margaret richardson					80305
Margaret Schulenberg					
margaret silver					32233
Margaret T.M. Petkiewicz					95125
Margaret Walker					40004
Margaret Williams-Ezell					49009
Margaret Zoch					77373
Margarita McLarty					59065
Marge Garvey					70001
Margith Maughan					84103
Margo Wilson					85022
Marguerite Molk					43229
Marguerite Shuster					91024
Marguery Lee Zucker					97403
Mari Dominguez					95236
Mari Vanantwerp					84047
Maria Asteinza					11375
Maria Bon					93063
Maria Luisa Tasayco					10033
Maria Mercedes monch					33185
Maria Millar					10023
Maria Miller					49505
Maria Moreira					4770-350
maria peteinaraki					71305
Maria Reis					70862010
Maria Studer					11756
Marian Ahler					30252
Marian Feldman					20878
Marian Hussenbux					
Marian Scena					60629
Marianella Torres					77077
Marianne Corona					06455
Marianne Flanagan					60018
Marie Banks					85701
Marie Bayus					23235
Marie Claire DeLuna					
MARIE CURTIS					7755
Marie Garescher					10566
Marie Grenu					61100
Marie Leven					48433
Marie Schlabach					38341
Marietta Smith					90401
Mariko Wheeler					86001
Marilee Bell					32966
marilyn gockowski					55811
Marilyn McClelland					V0R 1W0
Marilyn Rose					87111
Marilyn Waltasti					85138
marilynn mcgraw					38053
Marilynn Russell					95407
Marina Mooney					04607
Marina Morrone					11215
Marina Soto					97218
Mario Lario					10027
Marion Harukaze					69310
Maris Bennett					94509
Marisa Landsberg					90266
Marissa Lew					33179
marjorie angelo					32110
Marjorie Streeter					94501
Marjorie Williams					32079
Marjorie Wing					48911

Name of Sender	Organization	Street Number and Name	City	State	Zip
Mark & Jane Heald					38578
Mark Aziz					34232
Mark Blandford					79124
MARK BRADLEY					98122
Mark Canright					08802
Mark Cosgriff					44107
Mark Feldman					95401
Mark Good					59401
Mark Hanisee					92506
Mark Klugiewicz					77356
Mark Leeson					17961
Mark Levin					19462
Mark Lotito					11530
Mark Molloy					11238
Mark Novak					55427
Mark Ozog		1417 9th Street South #100	Great Falls	MT	59405
Mark Reback					90042
Mark S. Weinberger					94121
Mark Shotter					
Mark Soenksen					52742
Mark Volans					35811
Mark Wachowiak					32822
Mark Wirth					
markmseaton					
Marlen Hdz					14438
Marlena Lange					10940
Marlene Barrett					43537
Marliese Bonk					15218
Marsha Jarvis					94564
Marsha Warren					60201
Marta Calleja					70115
Marta Francis					46614
Marta Wood					40503
Martez Moody					63107
Martha Atkinson					99181
Martha Carrington					95062
Martha Gorak					77450
Martha Izzo					80439
martha jones					30117
Martha Lammers					38578
Martha Spencer					
Martie Enfield					32792
Martin Henderson					93117
Martin Jordan					62661
Martin Judd					7701
Martin Margolis					
Martina Hainke					44118
Martina Miscioscia					50100
MARTY BOSTIC					90025
Maru Derbick Johnson					60707
Mary Ann and Frank Graffagnino					85747
Mary Ann Baier					48124
Mary Ann Barrett					18042
Mary Ann Calvert					23452
Mary Ann Dunwell	Montana House of Representatives				
mary ann millay					55406
Mary Anne Guggenheim		100 Stuart Street	Helena	MT	59601
Mary Axle					48357
Mary Barbezat					60124
Mary Beth Farris					24563
Mary Camardo					60046
Mary Cernak					7731
Mary Delavan					79703
Mary Eide					55430
Mary Ferraro					80010
Mary Fineran					19031
Mary Germain					49074
mary grimaldo					75042
Mary Heller					12603
Mary Junek					53149
Mary Lester					14466
Mary Loomba					10595
Mary Lynn Parodi					97223
Mary McDermott					92887
Mary McGeary					11201
Mary Peterson					97365
Mary Rojeski					90405
Mary Shabbott					33950
Mary Thornton					76111
Mary Vorachek					97301

Name of Sender	Organization	Street Number and Name	City	State	Zip
Mary Waitz					94704
Mary Warren					75205
Mary Wellington					85704
Mary Williams					95603
Mary Wooldridge					21403
Mary Workman					32720
MaryAnn Linehan					19087
MaryAnna Foskett					2476
Mary-Betsy Spano					22556
MaryKay Rodarte					92371
Marylis Saltzmannn					7422
Maryn Jones					34691
MarySu Schetter					
Massimiliano Urso					0
Massimo Savigni					41124
matilde damian					3530
Matt Hargrave					
Matt Rice		600 N. Wolfe Street, Carnegie 180	Baltimore	MD	21287
Matteo Sisti					27050
Matthew Franck					8904
Matthew Genaze					02139
Matthew Hartlieb					85208
Matthew Knell					91304
Matthew Lipschik					
Matthew Nasser					90068
Matthew Richter					
Matthieu Brillet					49420
Matty Jewett					
Maureen K. Lighthiser		411 S 9th St	Livingston	MT	59047
Maureen Knutsen					
MAUREEN KNUTSEN					99633
Maureen Londino					
Maureen ONeal					97223
Maureen Saval					78641
Maureen Steffek					38125
mauricio carvajal					9291583
Maurits van Eijnatten					48838
Max Dorsi			Helena	MT	
Max Hjortsberg	Park County Environmental Council	P.O. Box 164	Livingston	MT	59047
Maxine Bernstein					10960
Maxine Clark					98310
May Shlotzhauer					
Mayelly Moreno					11201
Mazen Jishi					48187
Meg Dugan					85748
Meggi Stürmer					63820
Meghan MacKenzie					1778
Mehmet Bilgen					34710
Mel Stark					60552
melanie Feder					97370
Melek Korel					99999
Melinda Geiger					15042
Melinda Parke					98103
Melinda Richards					34610
Melissa Dorval					
Melissa Elder					17053
Melissa Fleming					1923
Melissa Hanmer					2809
Melissa Hastings					28570
Melissa Jenkins					96746
MELISSA JORDAN					13026
Melissa Murphy					94530
Melissa Owens					W10 5UE
Melissa van Wijk					10033
Melody Gray					80621
Melody Grigg					93455
Melody L Mead					89120
Mercy Drake					85205
MEREDITH ANDERSON					80234
Meredith Green					28205
Meredith Mohr					21921
Meredith Needham					43023
Meredith West					60622
Merle Foster					
Merlin Hay					BS22 9UN
Merrill S. Hawley	Hawley Hydrocarbons	314 S Colorado St	Conrad	MT	59425
Merry Harsh					88061
Meryle A. Korn					98226
Mesut Subasi					34743
Michael Abler					95062

Name of Sender	Organization	Street Number and Name	City	State	Zip
michael amescua					90032
Michael and Barbara Hill					98330
Michael Blakely					
michael blechman					94703
Michael Blodgett					94601
michael bordenave					93728
Michael Cecil					52601
Michael Darling					93225
Michael Eisenberg					27613
Michael Enk		PO Box 1408	Great Falls	MT	59403
Michael Essex					95762
Michael Fear					pe11 1jr
Michael Fine					20814
Michael Foote					
Michael Forzley		318 N 9th	Bozeman	MT	59715
Michael Friedmann					11237
Michael Gan					81007
Michael Garitty					95959
Michael Griffith		31C Stoney Brook Drive	Clancy	MT	59634
Michael Halloran					97305
Michael Ierulli					49686
Michael Iltis					53713
Michael LaGassey					33603
Michael Lawrence					15636
Michael Lieberman					33928
Michael Lighthiser Sr.		411 S 9th St	Livingston	MT	59047
Michael Lombardi					19054
Michael MacDougall					99026
Michael Martin					21144
Michael Martin					60189
Michael McGrath					58203
Michael Ober		54 Buffalo Hill Drive	Kalispell	MT	59901
Michael Olenjack					63109
Michael Potter					49236
Michael Sarabia					95207
Michael Schuessler					85719
Michael Schwaabe					20003
Michael Seager					44060
Michael Swanson					17603
Michael Terry					90402
Michael Tomczyszyn					94132
Michael Walters					2000
Michael Warwick					97306
Michael Zeller					48236
Michaellee Jones					
Michele Busler					01469
Michele Labrie					32976
Michele LaPorte					60148
Michele Martinez					
Michele Morris					46815
Michele Paxson					11554
Michele Temple					11377
Michele Villeneuve					37660
Michelle Ash					49651
Michelle Daddy					3245
Michelle Davis					95688
Michelle Dust					46322
Michelle MacKenzie					94025
Michelle Mondragon					32701
Michelle Murphy					08619
MICHELLE PUTZE					23235
Michelle Szabados					64151
Mickey White					73064
Mika Stonehawk					
Mike Butche					60504
mike butkiewicz					48313
Mike Carpenter					75227
Mike Chatlosh					92584
Mike Conlan					98052
mike corleone					90240
mike dellapenna					19355
Mike Fiebig	American Rivers				
Mike Griffith					
Mike Heimann		1 Jackson Creek Rd. PMB2342	Montana City	MT	59634
Mike Kaufman					55107
Mike LaPorte					97223
Mike Lyons					95476
Mike McCormick					
Mike Moore					
Mike Parsons					81020

Name of Sender	Organization	Street Number and Name	City	State	Zip
Mike Pasner					95946
Mike Peale					19014
Mike Stoakes					64063
Miles Nolte					
MILLARD Martin					98340
Millicent Sims					07042
Millie Colquitt					39042
Milt Weisman					32169
Mimi Hodsoll					22043
Mimi Lichtenberg					
mindy maxwell					2138
Minori Hinds					28748
Miok Fowler					80111
mirabai nagle					80301
Mireille Urbain					13000
Miriam Krausz					91604
Miriam Sexton					34698
Misha Petkevich					20817
Missy Kendrick					31605
Mitch Dalition					94117
moira					
Molly Greger					2890
Monica Drake					76012
Monica DuBina					46168
Monica Whyte					25401
Monique Edwards					85742
Monique La Roche					10706
Monique Tonet					6300
Morena Gambarelli					42013
Morgan Clark					07079
Morgan Cormia					7010
Moses Adams					27214
Mostyn Thayer					34952
Mr. and Mrs. Richard N. Huff					46815
Mr. G West					98201
Mr. Shelley Dahlgren					98029
mrkelly.burch					
Murlock					
MW					70123
Myles Hunt					11213
Mynka Draper					90042
Myra Dewhurst					33176
MYRIAM BOIS					4230
Myriam Pillon					82240
N Coyle					34958
N Karpel					6511
N. Newton					
nadine gregg					95062
Nady Corvers					15047
nan matthews					94044
Nanc Evoniuk					91364
Nancy and Buzz Constable		210 Fox Run	Livingston	MT	59047
Nancy Barcellona					90004
Nancy Bush					60622
Nancy Feuerbacher					85749
Nancy Fifer					19958
Nancy Goodwin					98625
Nancy Hansen					98056
Nancy Harlow					81007
Nancy Hauer					55110
Nancy Havassy					94611
Nancy Kelly					94605
Nancy Koury					6870
Nancy Mikelsons					60304
Nancy Moore					53705
Nancy Peterson					95066
Nancy Philips					5055
Nancy Riley					92799
Nancy Robinson					93555
Nancy Schuhrke					85224
Nancy Sharp					13104
Nancy Smith					90401
Nancy Spittler					94549
Nancy Ward					10028
Nancy White					99216
Nannette Taylor					97233
Naomi Klass					10011
Nasrin Mazuji					85635
Nat Latos					
Natalie Kovacs					92620

Name of Sender	Organization	Street Number and Name	City	State	Zip
Natalie Lucas					16502
Natalie Van Leekwijck					68844
Natasha Brenner					10002
Natasha Nitz					9263
Natasha Saravanja					94131
Natasja Torfs					
Nate Kluz		P.O. Box 238	Ulm	MT	59485
Nathan Cassiano					27408
Nathan D. Smith					
Nathan Stevens		5 Meadowlark Ridge	Great Falls	MT	59406
Nathan Stevens					
Neil Stafford					97527
Neilia Pierson					97523
Nelly Prestat					77169
Nelly Vasquez					28029
nelsonmike					
Neville Bruce					99501
Nicholas Arndt					38240
Nicholas Chatfield					Rm95ht
Nicholas Diamond					15131
Nicholas Lee					
Nicholas Lenchner					95403
Nicholas Robinson					32901
Nick Bell CH-8816					
Nick Duon					92705
nick evans					87401
Nick Gevock	Montana Wildlife Federation				
Nick Walsh					50240
Nico Font					Eh41dz
Nicola Gordon Bowe					66666
Nicola Jaeger					77389
Nicolás Altamirano					81303
nicolas estevez					10455
Nicole Green					98155
Nicole Kuehn					
Nicole Loh					
Nicole Sedkowski					2500
Nicole Shaffer					80917
Nigel Lim					53072
nikki.pachecotheard					
Nina Aronoff					
nina spelter					53703
Noah Marion					
Noah Youngelson					90066
Noel Crim					85375
Noel MacLeod					B2y3c6
Noel Orr					98155
Noemi Montoro Arcon					69007
Nora Gaines					10024
Nora Nelle					19426
Nora Sotomayor					
Norene Bailey					95062
Norma McNeill					
Norman Bishop					
Norman Brust					
Norman Hoffman					30068
Norman Kindig					92886
Nowzad Darwand					R3G3K9
O Lewis					90009
Olaf Janssen					52062
Oleg Varanitsa					98052
Olga Abella					62454
Olga Trojakova					90501
Olimpia Baraini					50033
Olive Ayhens					11211
Omar Siddique					21043
Orion Berryman					
Owen Gustafson					55313
P H					44002
P Jacquelyn Schmidt					1826
p.crouser600					
P.Jacquelyn Schmidt					01826
Pablo Bobe					10130
Paige McGlaughlin					80204
Pam Dinucci					60189
Pam Evans					75143
Pam Ferman					81427
Pam Miller					95660
Pam Rensch					97051
pam ward					3082

Name of Sender	Organization	Street Number and Name	City	State	Zip
Pamela and Robert Jiranek					
Pamela D. Wilson					97330
Pamela Gibberman					91402
Pamela Green					49001
Pamela Magathan					90068
Pamela Miller					76476
Pamela Sleeper					63021
Pamela Street					53717
Pamela Williams					07063
PAMELA WINBERRY-THOMPSON					38128
Pamylle Greinke					11958
Pandora Edmonston					95338
Paola Catapano					V9A 7M6
Parrie Henderson					20010
Pascale Laïk					75008
Pat Bunte					14224
Pat Dewar					
Pat Dufau					92673
Pat Halter					56082
Pat Hanbury					89506
Pat Keim					
Pat McCoy		34 Bingham Lane	White Sulphur Springs	MT	
Patrice Boyd					81241
Patrice Zboya					3303
Patricia Ames		809 Simons Drive	Missoula	MT	59803
Patricia Baley					89121
Patricia Brown					86402
Patricia Chadwick					10549
Patricia DeLuca					34275
Patricia Duran					10012
Patricia Fuss					94708
Patricia Greiss					17013
Patricia Harp					95355
Patricia Heckart					14886
Patricia Helvey		P.O. Box 867	Helena	MT	59635
Patricia Luevano Haworth					48130
Patricia Munn					8230
Patricia Nadreau					54660
Patricia Parker					17837
Patricia Pruitt					60302
Patricia Ranstrom					98070
Patricia Rossi					19056
Patricia Rowell, PhD					22308
Patricia Savage					93546
Patricia Sheridan					75070
Patricia Spencer					76271
Patricia Summers					91367
Patricia Vazquez					15900
Patricia Wynn					33186
Patrick Grady					97526
Patrick Hudson					48197
Patrick Keene					55418
Patrick Maloney					60657
PATRICK WATSON					80206
Patrik Pierce					4073
Patti Gallo					48085
Patty Bonney					97223
Patty Conrad					44118
Patty Haley					40391
Patty Rustad					81301
Paul Carmi					63128
Paul Desjardins					6096
Paul Eisenberg					47401
Paul Knapton					0
Paul Luehrmann					87501
Paul Manganiello					05055
Paul Martin					01923
Paul Moss					55110
Paul Riley					7871
Paul Russell					12472
Paul Sisson					98862
Paul Slack					ST4 3DZ
Paul Stephens					
Paul Stokes					SY19 7AJ
Paul Verzosa					33637
Paul Wages					
Paula Brungardt					80128
Paula Cano					
Paula Capaldo					19114
Paula Long					66441

Name of Sender	Organization	Street Number and Name	City	State	Zip
Paula Neville					14626
Paula Shafransky					98284
paulina Levinzon					08844
Pauline Rosenberg					19151
Pauline Winrow					6530
paulrea					
PEG HENDERSON					29625
Peg Miskin			Hamilton	MT	
Peggy Tibbetts					81652
Peggy Trenk	Treasure State Resource Association	P.O. Box 1700	Helena	MT	59624
Penny Derleth					99006
Penny Hammack					76180
perri glass					90068
pesceto					
Pete Klosterman					10025
pete rorvik					59864
Peter Bourriague					80503
Peter Corkey					94070
Peter Craig					78746
Peter Daniel					B980ND
Peter Fairley					89703
Peter Gunther					60659
Peter Holcomb					98226
Peter Kahigian					
Peter Kahigian					01831
Peter Madson		6835 Southridge Rd.	Billings	MT	59101
Peter R4TL Ch					32660
Peter Schafer					60605
Peter Schultz					60516
Peter Scott					84106
Peter Soule					2631
Peter Vandergrift	Costa Sunglasses				
Peter Wormley					53151
Petra Jones					12201
Phil Difani		37 Ricketts Road	Hamilton	MT	59840
Phil Hembury					12345
Phil Tompetrini					34442
Philip Aaberg		P.O. Box 5225	Helena	MT	59604
Philip Condit					98290
Philip Johnston					95066
Philip Khnopp					24421
Philip Kritzman					60659
Phillip Cripps					92234
Phillip Gagliardi					85262
Phoenix Giffen					94930
phuffman					
Phyl Morello					
Phyllis Chavez					90405
Phyllis Corcacas					10040
Phyllis Meyerparthemore					84741
Phyllis Wender					10065
Pierre Schlemel					11804
Piet Noppen					1541 HG
Pippa Pearthree					11218
Portland Coates					94704
Priscilla Newcomer					25405
Priscilla Tine'					37919
Probyn Gregory					91042
Prof. Gerhard Furrer					CH-8006
Querido Galdo					94601
r vanstien					7059
R.A. Dayton					15227
R.W. "Rich" McKamy					
R.W. McKamy		P.O. Box 2214	Billings	Montana	
Rachel Berg					10036
Rachel Fendal					59102
rachel Imholte					55417
Rachel Krucoff					60615
Rachel Scarlata					80814
Rachel Scott					53190
Rachel Wolf					95060
Rachelle Floin					N8A 2Y1
Rafael Ugarte					60647
Rakesh Chandranatha					80401
Raleigh Koritz					55442
Ralph "Riverwolf" Webb					
Ralph Emerson					30605
Ralph Rexroad					20159
Ralph Sanchez					95010
Randall Nerwick					97222

Name of Sender	Organization	Street Number and Name	City	State	Zip
Randall Shannon					46222
Randee Webb					80014
Randle Garner					77356
Randy Gray		2114 3rd Ave No	Great Falls	MT	59401
Randy Harrison					97402
Raphaël PONCE					31500
Ravinder Singh					11001
Ray Nuesch					22940
Ray Reece					78704
Ray Swiatkowski					75230
RAYA ENGLER					33162
Raymond Arent					21146
Raymond Collins					33177
Raymond Crannell					12839
Raymond Farrington					13207
Raymond Nuesch					20009
rc dutra					94587
Reba Reiser					84123
Rebecca Clark					91307
Rebecca Durham					59801
Rebecca Harper					90049
Rebecca McDonough					98245
Rebecca Miller					17307
Rebecca Woollett					99025
Rebekah Obrien					34653
REGINA BROOKS					15209
Régine Bohar					M4K 3A4
Regula Hess					95620
Reina Meloy	Pause Meditation				
Renata Jaksic					47000
Renate Heurich					70115
Renee Abousamra					97222
Renee Cariglia					89509
Renee Klein					90292
Renée Te					42144
Renya Sabosch					24837
Rev. Elizabeth Zenker					95521
Revs Drs Gerritt and Elizabeth Baker-Smith					18301
rex franklyn					94920
RHODA LEVINE					10003
Rhonda Bradley					38555
Rhonda D. Wright M.D					30319
Rhonda Green					90212
Rhonda Lawford					60474
Rhonda Sellers	Fly Fishers International				
Rhonda Wiggers	Montana Water Well Drillers				
Rhys Atkinson					94903
Ria Tanz Kubota					94803
Rich Hohne					
Rich Moser					93111
Rich Panter					29210
Richard and Kim Rendigs					2540
Richard DeSantis					92260
Richard E. Cooley					87111
Richard Edelman					02140
Richard Fehr					30277
Richard Guier					10025
Richard Han					48103
Richard Helton					37887
Richard Khanlian					87505
Richard Mendoza					67204
Richard Pecha					07849
Richard Peterson					60062
Richard Rafoth					98275
Richard Shannahan					21093
Richard Spratley					80020
Richard Waldo					84405
Rick Belding					95404
Rick Ellison					
Rick Lanham					62702
Rick Menendez					63012
Rick Sparks					91602
Rick Valois					
Rik Masterson					95959
Rinaldo S. Brutoco					93103
Rita Gentry					
Rita Lemkuil					54241
Rita Seclow					6612
Rob Bagley					92571

Name of Sender	Organization	Street Number and Name	City	State	Zip
Rob Carter					80026
Rob Gallinger					90042
Rob Seelman					13476
Rob Weiker					
Rob Weinberg					60190
Robb Mottl					84115
Robby Roberts					21401
Robert & Mary Swain					49506
Robert Agar					18360
Robert Aguirre					48451
Robert Ayers					85641
Robert Bates					21012
Robert Carlton					18360
Robert Chirpin					91324
Robert Clarke					6798
Robert Cruder					80107
Robert D. Carl, Ill		804 Kellerman Kreek	Marietta	Georgia	
Robert Drop					3171DE
Robert Engman					
Robert Erlick					91607
robert ferrara					82009
Robert Fingerman					37356
Robert Fischoff					88062
Robert H. Feuchter					11432
Robert Hall					94117
Robert Hicks					90803
Robert Jonas					7480
Robert Keiser					33143
Robert Linzmeier					60074
Robert Manning					12843
Robert Mcdonnell					92656
Robert Megraw					98042
Robert Mize					93527
Robert Oberdorf					33322
Robert Okroi					60410
Robert Posch					33305
Robert Pound					94518
Robert Reed					92651
Robert Richardson					80403
Robert Sanford					98607
Robert Sargent					1832
Robert Satler					61341
Robert Sullivan					95816
Robert Swab					45424
Robert Veralli					7480
Robert Wohlberg					55423
roberta e. newman					94941
Robin Craft					43064
Robin Gorges					5602
Robin Kory					33040
Robin Lorentzen					83607
Robin Nadel					6405
Robin Poole					
Robin poppe					55707
robyn devoist					14612
Rochelle Cohen					80231
Rocio Luparello					21702
Rocio Muhs					59803
Rod Brewer	Meagher County Board of Commissioners				
Rod Repp					91706
Rodney Nippert					
Rodolfo Sanchez					05001
Roel Cantu					78572
Roger Adams					25276
Roger Peffer		2517 9th Ave So	Great Falls	MT	59405
rohana wolf					60201
Romeo Tango					46204
Ron Burns			White Sulphur Springs	MT	
Ron Giddings					93402
Ron Hubert					86001
ron silver					32233
Ron Winter					
Ron Wish					10960
Ronald Clayton					
Ronald Drahos					47401
Ronald Gulla					15317
Ronald Harden				CO	80538
Ronald Howard					49046-9664
Ronald Lemmert					10566
Ronda Reynolds					29229

Name of Sender	Organization	Street Number and Name	City	State	Zip
Ronit Corry					93101
Rosalind Bresnahan					92405
Rosanne Anderson					99004
Rose Henderson					90044
Rose Reina-Rosenbaum					8844
Roseanne Hovey					92117
Rosemary Caolo					18510
Rosemary Griffith					96825
Ross Chaney			Missoula	MT	
Roth Woods					
rotraud coffey					33611
Routin Carole					75017
Rox Colby					77583
Roy Munroe					
Royal Chamberlain					14619
Rozn Jon					
Ruben Carrasco					79705
Russell Hartzell		1848 S 11th St W #A	Missoula	Montana	
Russell Se					05301
Russell Weisz					95060
Ruth cassilly					21028
Ruth Darden					98101
Ruth Mendes					10576
Ruthie Bernaert					96727
Ryan Thompson			Bonner	MT0	
rynakatani					
s da silva					bh89qq
S Hall					30305
S Kaehn					94601
S Logan					33131
S. Jordan					33441
S. M. Schumann					12534
S. Thomas Bond					26378
S. Wayne Chamberlin		1708 Gold Rush Ave.	Helena	MT	59601
Sabrina Wojnaroski					15238
Sagen Smith					97520
Sally Hills					85739
Sally Small					46219
Salvatore Greco					96100
sam asseff					80915
Sam Butler					90045
Sam Haraldson					
Samantha Turetsky					32176
Sammia Panciocco					3079
Sammy Low					98292
Samuel Durkin					94534
Sanand Dilip					1348
Sanand Dilip					44601
Sanand Dilip					01348
Sanda Logan					
Sandra Angelini					4520
sandra arapoudis					85133
SANDRA BEITLER					19440
Sandra Carter					33549
Sandra Cobb					44022
Sandra Cope					92612
Sandra Costa					
Sandra Costa					41000
Sandra Franz					60657
Sandra Frohling					54729
Sandra Geyer					92028
sandra hazzard					33578
sandra jackson					87508
Sandra Joos					97239
Sandra Kisieleski					7734
Sandra Klueger					53048
Sandra Lambert					06250
Sandra Lynn					78620
Sandra Materi					82604
Sandra Miller					46635
Sandra Monard					59400
sandra musella					1801
Sandra Oliver-Poore					97301
Sandra Reeves					77006
sandra schomberg					97330
Sandra Vandersluis					61265
Sandra Walker					92688
sandra zuckerman					08873
Sandrine Bernard					04350
Sandy Cameron					95076

Name of Sender	Organization	Street Number and Name	City	State	Zip
Sandy Dumke					57020
Sandy Spears					77005
sandy spears					77005
Sandy Zelasko					92082
Sanja Futterman					98115
Sara Avery					80026
Sara Barsel					55113
Sara Garcia					SN2 1QD
Sara Hayes					90814
Sara Hopewell					64114
Sara Lazarus					07041
Sara Meloy					
Sara Polk					84604
Sara Rathfon					49423
Sarah Barrett					60515
Sarah Blumenstein					
Sarah Dean					20009
Sarah Desousa					78070
Sarah Dolinar					10304
Sarah Gooderham					19805
sarah Lincoln					05473
sarah Lincoln					05473
Sarah McKee					01002
Sarah Reese					22203
Sarah Sercombe					48073
Sarah Stafford					
Sarah Stahelin					56601
Sarah Townsend					94086
Sarah Wiebenson					97227
Sarai Aveleira					48510
Sarajo Frieden					90027
Saran K.					
Satya Vayu					97206
Savath Pouv					92804
Sawyer Connelly	Backcountry Hunters & Anglers	1539 S 11th St	Missoula	Montana	
Scott Anderson					
Scott Bosse	American Rivers	321 East Main Street	Bozeman	MT	59715
Scott Calvin					75056
Scott Cottrill					87123
scott finamore					34433
Scott Hed					57231
Scott Laird	Theodore Roosevelt Conservation Partnership				
Scott MacDougall					94709
Scott Rubel					90031
Scott Sando					16345
Scott Sweeney	Fergus Electric Cooperative	84423 US Highway 87	Lewiston	MT	59457-2058
Scott Whitacre Scott Whitacre					43713
Sean O'Dell					98056
Seisin Eyer					59803
Selma Cooper					77042
Senta Tsantilis					94122
Sergio Rivera					60634
Seth Silverman					10028
SGT David Winsett					
sha davies					96001
shana Smith					12754
Shanda Stuart					Ex388bs
Shane Vatland					
Shannon Meadows					61607
Shannon Peters					97132
Shannon Schneble					94110
Shannon Whitaker		25 Peninsula Road	White Bear Lake	MN	55110
Shanti Copeland					32246
Shari Sutherland					59714
Sharon Adams					25428
Sharon Balzano					80033
Sharon Budde					94521
sharon bykerk-lonergan					7304
Sharon Christopher					53222
Sharon Fortunak					55114
Sharon Frank					75077
Sharon Hurley					25267
Sharon Jones					44233
Sharon Kamarainen					49837
Sharon Ketcherside					95648
Sharon Koe					60171
sharon lacy					95472
Sharon Longyear					10598
Sharon Parshall					98024

Name of Sender	Organization	Street Number and Name	City	State	Zip
Sharon Porter					95969
Sharon Robyn					81226
Sharon Saunders					98465
Sharon Stork					44124
Sharon Wakefield					60134
Sharon Widigan					48449
Sharyn Radke					48093
Shauna Sparlin					67235
shawn johnson					92024
Shawn Tays					6040
Shearle Furnish					72223
Sheila Desmond					95682
Sheila Miller Sheila Miller					1106
Sheila Roddy					67205
Sheila Silan					95684
Shellie Ljungquist					21054
Sherilyn Coldwell					78212
Sherri Kalman					87198
Sherri Wright					81212
Sherrie Raymond					37918
Sherrill Futrell					
Sherry Lewis					87594
Sherry Luke					95311
Sherry Quinn					80920
Sherry Weiland					01749
Sheryl Williams					40222
Shinann Earnshaw					
Shirley Harris					95490
Shirley Obeya					20814
Shirley Powell					53038
Shonda Hannah					30188
Sidney Robles					94558
Sieglinda Preez					
Sigrid Dr. Neef					37688
Silvia Hall					33431
Simon Draper					NN5 6NH
Simone Cividini					24044
Simone Dail					78660
Simran Khalsa					90034
Smith Wells		619 1st Street	Helena	MT	59601
Sofi Nordstrom					32309
Sofie Forsberg					4750
SONDRA BOES					95008
Sonia Goldstein					100011
Sonia Zainko					25750020
Sonja Nielsen					26000
Sonya Rencevicz					06830
Sophia McAskill					60074
Sophia Vassilakidis					77006
Sophie Danison					
sophie deruiter					98597
Stacey Sklute					90034
Stacia Haley					98108
Stacie Charlebois					95472
Stacy Andrade					
Stacy Grossman					43209
Stan Sheggeby					
Stanley Charles					29715
Stavros Sofokleous					1071
Stefania Johns					48001
Stefany Garza					78557
stella lin					75080
Stephan Meyer					86322
Stephanie Clark					1506
Stéphanie CLEMENT-TERRAY					31170
Stephanie Fairchild					43725
Stephanie Lovell					34668
Stephanie McFadden					44070
Stephanie Silva					52246
Stephanie Trudeau					33406
Stephany Aguilar					95066
Stephen Bohac					95383
Stephen Boletchek					27502
Stephen Dutschke					40207
Stephen Gerdes		3300 E Graf Street Unit 91	Bozeman	MT	59715
Stephen Greenberg					95959
Stephen Howard					5047
Stephen La Serra					2180
stephen marshall					08012
Stephen McClasky					33312

Name of Sender	Organization	Street Number and Name	City	State	Zip
Stephen Pew					98683
Stephen Potenberg					
Stephen Wilson					97388
Steve Bullock	Governor				
Steve Garrett					97411
Steve Gilbert		604 Second Street	Helena	MT	59601
Steve Gilbert					
Steve Grundy					BA5 1RZ
Steve Harrell					
Steve Hicks		PO Box 394	White Sulphur Springs	MT	
Steve Kiffmeyer					
Steve Mattan					8088
Steve Perakis					
Steve Robey					94708
Steve Sheehy					97603
Steve Sugarman					90265
Steve Troyanovich					8518
Steve Wanninger					61103
steve.ballenger134					
steven allen					g42 7rx
steven carpenter					48183
Steven Christian					97123
Steven Combes					32608
Steven Esposito					11776
Steven G. Kellman					78231
steven hoffman					21208
steven korson					92503
Steven Schafer					97075
Steven Smith					8106
Steven Steele					55311
Steven Tichenor					
stijn Bruers					2100
Stuart Lewin		615 3rd Ave North	Great Falls	MT	
stullhe					
Su Horty					19806
Su Johnson					
Suan Rego Ross					63016
Sudeshna Ghosh					70121
Sue and John Morris					5658
Sue Chard					37148
Sue DeArman					98370
Sue E. Dean					80501
Sue Habegger					95949
Sue Johnson		2400 Durston Rd #35	Bozeman	Montana	
Sue Martin					92102
Sue Schummer					98077
Sue Velez					8075
Sue Vinton					
sukhgerel digersuren					80403
Summerfield Baldwin					10707
Susan Alice Mufson					10011
Susan Babbitt					19107
Susan Berlin					94903
Susan Brandes					85716
Susan Campbell					32162
Susan Chapman					BH5 2BS
Susan Clelland					10522
Susan Clifford					34655
Susan Colvin		287 McIver Rd	Great Falls	MT	59404
Susan Delles					
Susan Dimmock					6067
Susan Dobbelaere					66223
Susan Dorchin					33446
Susan Edelstein					27511
Susan Enzinna					80020
Susan Fairweather					99999
Susan Gemmill					80206
Susan Harmon					77707
Susan Hathaway					90660
Susan Heath					
Susan Heywood					98408
Susan Johnson					84318
Susan Kozinski					53235
Susan Kutz					88012
Susan Maderer					10025
Susan McCarthy					22603
Susan McDowell					
Susan McMullen					91945
susan michetti					53572
Susan Miller					18661

Name of Sender	Organization	Street Number and Name	City	State	Zip
Susan Monteiro					SE12 9LB
susan peirce					80540
susan peirce					87506
Susan Richeson					11967
Susan Rodriguez					85260
Susan Schuchard					37135
Susan Selbin					87104
Susan Shaak					19606
Susan Soper		604 Wintergreen Ct.	Helena	MT	59601
Susan Spengler					60074
Susan Tackett					28701
Susan Termini					32952
Susan Thomas					
Susan Tucker					16365
Susan Wechsler					97330
Susan Willard-Killen					01775
Susan Wilson					98031
Susanna Purucker					33139
Susannah Phillips					21012
Susanne Groenendaal					16801
Susanne Murray					99223
Susie Cassens					
Suzanna Hagglof					17150
Suzanne a'Becket					95014
Suzanne Baxter					19003
Suzanne Deerlyjohnson					90806
Suzanne Degnats					30345
Suzanne Flanegan					CM23 4JS
Suzanne Gordon					33990
suzanne Hedrick					4555
Suzanne Koch					92067
Suzy Berkowitz					33470
Suzy Sayle Suzy Sayle					80487
Svskier					
Sybil Schlesinger					1760
Sylvia Ramsey					21045
T Garmon					30534
T J Thompson					98335
T Mo					55076
T.G					60466
Takako Ishii-Kiefer					07747
Tamara J. Johnson	Montana Mining Association	P.O. Box 1026	Whitehall	MT	59759
Tamara J. Johnson	Montana Mining Association				
Tamara Matz					90016
Tami Beck					72250
Tami Hillman					32931
Tami Linder					87144
Tami McCready					93063
Tami Palacky					22153
Tami Phelps					96003
Tammy Bernot					
Tammy Fisher					46303
Tammy Nogles					19010
Tania Cardoso					2302
Tanja Lepikko					33332
Tanya Gerard					28604
Tanya Pierce					32736
Tara Gonzales					93422
Tara Huber					20853
Tara Sumner					13468
tara wheeler					22124
Tarn Ream					59801
Tatiana Medina					33122
Ted Neumann					12009
Ted Walkup					80521
Ted Wray					19320
Teresa Cambridge					46254
Teresa Richardson					33609
Teresa Wall					85201
Teresa Woods					33543
Terri Roach		1583 Fox Field Drive	Missoula	MT	59802
Terri Schneider					10989
terry creech brunt					80470
Terry Friedman					07645
Terry Gauthier		P.O. Box 4939	Helena	MT	59604
Terry Gauthier					
terry king					01773
Terry Oconnor		4 Wild Grass Ct	Clancy	MT	59634
Terry Poulson					43512
Terry S.C.					93455

Name of Sender	Organization	Street Number and Name	City	State	Zip
Terry Tedesco-Kerrick					85016
Teseo Staffilani					64018
Tess Husbands					
The Rev. Mary Louise Allen					
Theresa Deery					29909
Theresa Hadden-Martinez					87043
Theresa Murphy					10708
THERESA OWENS					94558
Theresa Thornburg					32569
Thomas Barry					86303
Thomas Bott					15108
Thomas Campanini					17403
Thomas Hammond					98115
Thomas Knecht					93424
Thomas Koven					8827
Thomas Leonard					10467
Thomas Libbey					98122
Thomas McCormick					2892
Thomas Miller					17019
Thomas Nelson					19050
Thomas Sarelas					60630
Thomas Simon					
Thomas Smith					84780
Thomas Viceconte					85748
Thomas Williams					85648
THUHA TRAN					92708
Tibor Gacs					00000
Tiffany Snyder					80305
Tim Barrington					95112
Tim Dressel					92109
Tim Glover					32976
Tim Gundlach					94070
Tim Hanify					92028
Tim Ryan					92624
Tim Speyer		1060 Strawberry Dr	Helena	MT	59601
Tim Stein					29579
Tim Stevens			Livingston	MT	
tim storer					85716
Timothy Beitel					08071
Timothy Gilmore					94109
Timothy Lippert					33625
Timothy Post					66064
Timothy Schacht					48230
Tina Ann					94924
Tina Brenza					61111
Tina Colafranceschi					
Tina Doolen					
Tina Shurtleff					28906
Tina Tine					37919
Tirso Moreno					32703
TJ Brooks					72632
Toby Ann Reese					44280
Toby Krutz					
todd atkins					02762
Todd Hildebrandt					97437
Toff Hahn					77478
Tom Beatini					7642
Tom Cate					
Tom Coleman					
Tom Creswell					97338
Tom DiNicola					44319
tom harris					8016
tom kovalicky					83530
Tom Quinn					
Tom Tripp					80524
tomoyuki torii					162-0056
Tony Angland		Castle Bar on Smith River, 2800 4th Avenue North	Great Falls	MT	59401
Tony Angland		Castle Bar on Smith River, 2800 4th Avenue North	Great Falls	MT	59401
Tony Lilich					74066
Torunn Sivesind					95678
Tory Ewing					61835
TR Hart					
Tracey Ferguson					R3J 0N5
Tracey Holmes					07467
Tracey Katsouros					20601
Tracie Gabrisko					
Tracy Leigh					80482
Tracy Ouellette					98232

Name of Sender	Organization	Street Number and Name	City	State	Zip
Tracy Strickland					80123
Travis Campbell		2719 Emery Place	Missoula	MT	59804
Travis Jennings					77502
Travis Miller					98122
Trenton Kriz					
Tresa Shiner			Butte	MT	
Trevor Heneveld					95817
Trevor Van Wyk					2092
Trigg Wright III					77379
Trina Cooper					98106
Trini Moreno					64507
Trish McCoy					
Tristan Sophia					59069
Troy Bidwell					37934
Twila Friberg					97128
Ulrike MacKay					96352
Uta McQuade					8831
V Evan					60660
Valerie Bergeron					3878
Valerie Brown					21032
Valerie Hildebrand					44134
Valerie Morgan					24012
Valerie Nordberg					11120
Valerie Romero					95971
Valerle Leonard					21045
Vanessa Kohlgruber					50823
Vanessa seay					45432
Veerle van de Velde					9700
Velina Dinkova					80305
Vernon Batty					81147
Veronica Aguirre-Dutton					93013
Veronica Bourassa					37332
Veronica Rehne					80426
Veronika Egli-Steinegger					9479
Vesna Glavina					52556
Vic Bostock					91001
Vicki & Rod Kastlie					92107
Vicki Bingo					90036
Vicki Gannon					85742
Vicki Gold					96067
vicki hughes					92648
Vicki Johnson					64137
Vicki Root-Wajda					60181
Vicky Keays					92021
Vicky Matsui					98122
victor carmichael					94044
Victor Escobar					23113
Victoria Miller					91436
Victoria Olson					33309
Victoria Swanson					93013
Vince Bjork					51449
Vincent DiTizio					10312
Vinnie Serapiglia					10312
VIOLET GAUTESEN KRUKONIS					05452/3780
Violet Houtzagers					68713
Virginia Utt					32935
Virginia Wasserman					43338
Virginia Watson					90026
virginie bellon					57200
virna mellini					53
Vivian James					GU30 7PW
W Glover					89801
W Kent Wilson					97229
W. Andrew Stover					17201
W. Clark					24501
Wallace Rhine					95421
Walter Loquet					23320
Walter Ramsey					94561
Walter Schmitt					
Walter Tulys					08861
Wanda Ballentine					55105
Wanda Pettus					29072
Wanda Plucinski					8512
Warren and Theresa Knapp					18848
Warren Hopper			Helena	MT	
Wayne Chamberlin			Helena		
Wayne Kelly					97520
Wayne Langley					75050
Wayne Ott					17243
Wayne Stalsworth					78155

Name of Sender	Organization	Street Number and Name	City	State	Zip
Webb Brown	Montana Chamber of Commerce				
Wendi Cohen					10562
Wendi Myers					34683
Wendy Balder					21053
Wendy Fast					14437
Wendy Forster					
Wendy Van Oosterwijck					02840
Wesley Tyler					44077
Wesley Wada					97701
Whitcomb					
Wiesje Slot					9561DG
Wilder Kingsley					11201
Will Copeland					
Will Trimbath	Trout Unlimited				
William Avey	Helena-Lewis and Clark National Forest	2880 Skyway Drive	Helena	MT	59602
William Bader					18018
William Baumgartner					80302
William Carmen					11420/2112
William Crist					94044
William Cumming					11111
William Dearstyne					01970
William Friedrich					10960
William Gaskill					41094
William Hunter					91104
William Kelley					34275
William Lewis					80013
William M. Musser IV					95125
William Maynard					20715
William McMullin					
william mittig					95338
William Pfeiffer					2132
William Rastetter					19111
William Ridgeway					18504
William Ryerson					46228
William Schoene					
William Sharfman					10024
William Skirbunt-Kozabo					23831
William Stone					78757
William Webster					95966
Wim Van Caelenbergh					9000
Wolfgang Lippel					
Wyman Whipple					61428
Wynn Shafer					44122
Yael Shimshon					0
Yi-Mei Lu					11373
ynez fernandez					96793
Yo Pere					30300
Yves Decargouet					95458
Yvette Tapp					87506
Yvonne Barker					53214
Yvonne Depuy					11772
Yvonne Fast					
Yvonne Kostelecky					
Yvonne Pratt					11772
Zak Mettger					02906
Z'ava Rosen					92203
zelma fishman					93402
Zoe Strassfield					11976
Zola Packman					27605
	Cascade Conservation District	12-Third St. NW, Suite 300	Great Falls	MT	

APPENDIX K

Preliminary Determination on Air Quality Permit Application

PRELIMINARY DETERMINATION
ON PERMIT APPLICATION

Date: March 11, 2019

Name of Applicant: Tintina Montana Inc.

Source: Underground Copper Mine and Mill Site

Proposed Action: The Department of Environmental Quality (Department) proposes to issue a permit, with conditions, to the above-named applicant. The application was assigned Permit Application Number 5200-00.

Proposed Conditions: See attached.

Public Comment: The original preliminary determination was issued on June 5, 2018, with a subsequent 30-day public comment period ending on July 5, 2018. Comments received during the 30-day comment period have been incorporated into this revised preliminary determination. The Department is taking additional comments on this revised preliminary determination and taking comments on any air quality items included in the Draft version of the Environmental Impact Statement (EIS) which will inform the air quality permit. Any comments on the revised preliminary determination are due the same date as the comments are due for the Draft EIS.

Departmental Action: The Department intends to make a decision on the application within 30-days after the Final EIS is released. The permit shall become final on the date stated in the Department's Decision on this permit, unless an appeal is filed with the Board of Environmental Review (Board).

Procedures for Appeal: Any person jointly or severally adversely affected by the final action may request a hearing before the Board. Any appeal must be filed by the date stated in the Department's Decision on this permit. The request for a hearing shall contain an affidavit setting forth the grounds for the request. Any hearing will be held under the provisions of the Montana Administrative Procedures Act. Submit requests for a hearing in triplicate to: Chairman, Board of Environmental Review, P.O. Box 200901, Helena, MT 59620.

For the Department,

Julie A. Merkel
Permitting Services Section Supervisor
Air Quality Bureau
(406) 444-3626

Craig Henrikson, P.E.
Environmental Engineer
Air Quality Bureau
(406) 444-6711

JM:CH
Enclosures

MONTANA AIR QUALITY PERMIT

Issued to: Tintina Montana Inc.
P.O. Box 431
White Sulphur Springs, MT 59645

MAQP: #5200-00
Application Complete: 05/11/2018
Preliminary Determination Issued: 06/5/2018
Revised Preliminary Determination: 03/11/2019
Department's Decision Issued:
Permit Final:

A Montana Air Quality Permit (MAQP), with conditions, is hereby granted to Tintina Montana Inc. (Tintina), pursuant to Sections 75-2-204 and 211 of the Montana Code Annotated (MCA), as amended, and Administrative Rules of Montana (ARM) 17.8.740, *et seq*., as amended, for the following:

Section I: Permitted Facilities

A. Permitted Equipment

Tintina is proposing to develop and operate a new underground copper mine and mill identified as the Black Butte Copper Project (BBCP). The BBCP proposes to produce and ship copper concentrate mined from both the upper and lower zones of the Johnny Lee copper deposit. The area of the planned permit boundary encompasses 1,888 acres of privately owned ranch land under lease to Tintina. Mine life is estimated at approximately 19 years including two years of construction/pre-production, 13 years of active production mining, followed by four years of reclamation and closure. A complete list of permitted equipment is contained in Section I.A of the permit analysis.

B. Plant Location

Tintina proposes to develop the BBCP approximately 15 miles north of White Sulphur Springs in Meagher County, Montana. Total surface disturbance required for construction and operation of all mine-related facilities and access roads comprises approximately 311 acres. The proposed mine permit area resides in Sections 24, 25, and 36 in Township 12N, Range 6E, and Sections 19, 29, 30, 31, and 32 in Township 12N, Range 7E, Meagher County, Montana

Section II: Conditions and Limitations

A. Emission Limitations

1. Tintina shall be limited to a maximum of 2.19 million tons of waste rock as measured by the total material processed by the Portal Crusher (P1) during any rolling 12-month period (ARM 17.8.749).

2. Tintina shall be limited to a maximum of 1.46 million tons of ore as measured by the material processed by the weight meter following the coarse ore bin and prior to entering the mill during any rolling 12-month period (ARM 17.8.749).

3. Tintina shall be limited to a maximum usage of 1,552 tons of ammonium nitrate fuel oil (ANFO) during any rolling 12-month period (ARM 17.8.749).

4. Tintina shall be limited to a maximum total usage of 4,180,000 gallons of propane for the Upper Copper Zone Propane Heater (P10A) and the Lower Copper Zone Heater (P10B) during any rolling 12-month period (ARM 17.8.749).

5. Tintina shall be limited to diesel-fired generator sets for surface mine equipment including P2, P4, P5, P6, P17, P18 and F26 of a maximum rated design capacity of the generator engine(s) not exceeding 2,735 brake-horsepower (bhp). This condition does not include the ratings from the four emergency diesel generators P7A, P7B, P8 and P9 (ARM 17.8.749).

6. Tintina shall be limited to a maximum total usage of 806,384 gallons of diesel fuel for mobile equipment, stationary and portable equipment for both surface and underground operations during any rolling 12-month period (ARM 17.8.749).

7. Tintina shall not cause or authorize to be discharged into the atmosphere any fugitive emissions from process equipment not covered under 40 CFR 60, Subpart LL that exhibit 20% opacity or greater averaged over 6 consecutive minutes (ARM 17.8.308).

8. Tintina shall limit process fugitive emissions for any affected facility as identified in 40 CFR 60, Subpart LL, from the date of the performance test (as required by Section II.C.1) forward, to a maximum opacity of 10%. Stack emissions from any affected facility are limited to a maximum of 7% opacity unless using a wet scrubber (40 CFR Part 60, Subpart LL, ARM 17.8.308 and ARM 17.8.340).

9. Tintina shall formalize a Fugitive Dust Control Plan from the elements approved in the BACT analysis to control fugitive dust and comply with ARM 17.8.308 - Airborne Particulate Matter (Reasonable Precautions). This plan shall include all mine areas including roads utilized within the mine permit boundary as defined by the Montana DEQ Hardrock Operating Permit. The plan should include four elements common with best management practices. 1) Staff titles responsible for carrying out the Fugitive Dust Control Plan. 2) Identification of dust control problems. 3) Recommended strategy or strategies for resolution. 4) Documentation of corrective action.

   Prior to the commencement of operation, Tintina shall submit the Fugitive Dust Control Plan to the Department for review and input. Tintina may develop separate plans based on the current phase of the mine; development, production and reclamation (ARM 17.8.749 and ARM 17.8.752).

10. Tintina shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any sources installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.304).

11. Tintina shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter (ARM 17.8.308).

12. Tintina shall treat all unpaved portions of the haul roads, access roads, parking lots, or general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precautions limitation in Section II.A.9 and Section II.A.11 (ARM 17.8.749 and ARM 17.8.752).

13. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 60, Subpart A and 40 CFR 60, Subpart LL (ARM 17.8.340, 40 CFR 60 Subpart A and 40 CFR 60 Subpart LL).

14. Emissions from the dust collectors controlling emitting points P12, P13A, P13B, P14 and P15 (Jaw Crusher Building, Mill Building Areas, Surge Bin Discharge, and Water Treatment Area) and shall be limited to a maximum of 0.01 grains per dry standard cubic foot (gr/dscf) (ARM 17.8.340, 40 CFR Part 60, Subpart LL and ARM 17.8.752).

15. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 60 Subpart IIII for the four units identified as emergency generators. These are identified as P7A, P7B, P8 and P9 (ARM 17.8.340 and 40 CFR 60 Subpart IIII).

16. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 63 Subpart ZZZZ for the four units identified as emergency generators. These are identified as P7A, P7B, P8 and P9 (ARM 17.8.342 and 40 CFR 63 Subpart ZZZZ).

17. The four emergency generators shall be used for emergency or back-up operations only and shall each be limited to 500 hours of operation during any rolling 12-month time period. Preventative maintenance activities shall be included in the 500 hours of operation during any rolling 12-month time period (ARM 17.8.749).

18. Tintina shall use diesel engine/generators which satisfy 40 CFR Part 89 and/or 1039 for non-road engines (ARM 17.8.752, ARM 17.8.340 and 40 CFR 60 Subpart IIII).

19. Diesel-fired engines P2, P4, P5, P6, P7A, P7B, P8, P9, P17, P18, and F26 shall be a minimum of EPA Tier 3-rated engines (ARM 17.8.749).

B. Emission Control Practice and Requirements

1. Underground Blasting – Industry Best Operating Practices (BOPs) shall be used for minimizing blasting emissions, including hole size optimization, placement optimization, optimizing the quantity of explosive, and mine planning to prevent overshooting (ARM 17.8.752).

2. Ore transferred from the jaw crusher to the mill building shall be done in an enclosed conveyor (ARM 17.8.752).

3. Portable Crusher (P1) and two Screens (P3) shall use reasonable precautions including water spray suppression for particulate control (ARM 17.8.752).

4. Diesel-fired engines P2, P4, P5, P6, P17, P18, and F26 meet 40 CFR 60, Subpart IIII (ARM 17.8.340, 40 CFR 60, Subpart IIII and ARM 17.8.752).

5. Propane Heaters P10A and P10B shall be rated for a maximum of 75 MMBtu/hr total and shall utilize clean burning fuel (propane or equivalent) and utilize good combustion practices (ARM 17.8.752).

6. Temporary Diesel-fired Portal Heaters (P11-Up to 3 diesel-fired engines with a 1.2 MMBtu/hr total)) shall use diesel fuel or equivalent and utilize good combustion practices (ARM 17.8.752).

7. Temporary Portable Propane-fired Heaters (F28-Up to 9 units with a 37.8 MMBtu/hr total) shall use propane or equivalent and utilize good combustion practices (ARM 17.8.752).

8. Emitting Units P12, P13A, P13B, P14, and P15 (Jaw Crusher Building, Mill Building Lime and Lime Silo Areas, Surge Bin Discharge, and Water Treatment) shall use dust collectors for particulate control (ARM 17.8.752).

9. Backfill Plant Cement Operations including Fly Ash Hopper and Fly Ash Silo (P16A and P16B) shall use dust filters/collectors for particulate control (ARM 17.8.752).

10. All road sections and all stockpiles (ore, waste rock, excavated bedrock, topsoil, subsoil and temporary construction material etc.) shall utilize reasonable precautions for particulate control. For stockpiles, this may include wind-fencing and/or treatment with water or chemical dust suppressant (ARM 17.8.752).

11. Soil and subsoil stockpiles saved for mine reclamation will be revegetated in place within two growing seasons following their completion (ARM 17.8.752).

12. If water and/or chemical dust suppressant are not effective for controlling fugitive dust, Tintina shall also require vehicle restrictions including the use of vehicle speed limits to further reduce fugitive dust (ARM 17.8.752).

C. Testing Requirements

1. The affected facilities under 40 CFR 60, Subpart LL shall be tested and demonstrate compliance with the emission limitations contained in Section II.A.8 within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of the affected equipment (ARM 17.8.105, ARM 17.8.340, 40 CFR 60.8 and 40 CFR 60, Subpart LL).

2. All compliance source tests shall conform to the requirements of the Montana Source Test Protocol and Procedures Manual (ARM 17.8.106).

3. The Department of Environmental Quality (Department) may require further testing (ARM 17.8.105).

D. Operational Reporting Requirements

1. Tintina shall supply the Department with annual production information for all emission points, as required by the Department in the annual emission inventory request. The request will include, but is not limited to, all sources of emissions identified in the emission inventory contained in the permit analysis.

   Production information shall be gathered on a calendar-year basis and submitted to the Department by the date required in the emission inventory request. Information shall be in the units required by the Department. This information may be used to calculate operating fees, based on actual emissions from the facility, and/or to verify compliance with permit limitations (ARM 17.8.505). Tintina shall submit the following information annually to the Department by March 1 of each year; the information may be submitted along with the annual emission inventory (ARM 17.8.505).

   a. Amount of ore produced as measured by the weight meter downstream of the coarse ore bin.

   b. Total gallons of diesel fuel used by underground equipment and above-ground equipment.

   c. Gallons of propane used by P10A and P10B.

   d. Tons of ANFO explosive used.

   e. Hours of operation of each of the four emergency diesel-fired generators.

   f. An estimate of company vehicle miles traveled on the main mine roads.

   g. Amount of disturbed acreage by stockpile and material type.

2. Tintina shall notify the Department of any construction or improvement project conducted, pursuant to ARM 17.8.745, that would include ***the addition of a new emissions unit***, change in control equipment, stack

height, stack diameter, stack flow, stack gas temperature, source location, or fuel specifications, or would result in an increase in source capacity above its permitted operation. The notice must be submitted to the Department, in writing, 10 days prior to startup or use of the proposed de minimis change, or as soon as reasonably practicable in the event of an unanticipated circumstance causing the de minimis change, and must include the information requested in ARM 17.8.745(l)(d) (ARM 17.8.745).

3. All records compiled in accordance with this permit must be maintained by Tintina as a permanent business record for at least 5 years following the date of the measurement, must be available at the plant site for inspection by the Department, and must be submitted to the Department upon request. These records may be stored at a location other than the plant site upon approval by the Department (ARM 17.8.749).

4. Tintina shall document, by day, the waste rock production levels as measured by the number of trucks transported from the portal. An estimated density per truckload should be applied for the calculation either based on an expected density or actual determination. By the 25th day of each month, Tintina shall document the total tons of ore processed for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation Section II.A.1. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

5. Tintina shall document, by month, the ore production levels as measured by the weight meter downstream of the coarse ore bin. By the 25th day of each month, Tintina shall document the total tons of ore processed for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.2. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

6. Tintina shall document, by month, the tons of ANFO explosive used at the site. By the 25th day of each month, Tintina shall document the total tons of ANFO explosive used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.3. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

7. Tintina shall document, by month, the gallons of propane used by P10A and P10B. By the 25th day of each month, Tintina shall document the total gallons of propane used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.4. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

8. Tintina shall document, by month, the diesel fuel consumption of all the underground equipment and above-ground equipment. By the 25th day of each month, Tintina shall calculate the total diesel fuel consumption for

diesel-fired equipment for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.6. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

9. Tintina shall document, by month, the hours of operation of each emergency diesel-fired generator (P7A, P7B, P8 and P9). By the 25th day of each month, Tintina shall document the total hours of operation of the diesel engine/generator for the previous month. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

10. Tintina shall provide documentation that the equipment installed at the site which relied on specific dispersion characteristics for ambient air quality modeling, is consistent with the modeled assumptions. These parameters are primarily exhaust flow, engine size (bhp), stack height and stack diameter. Alternatively, Tintina shall provide a demonstration that any significant differences in dispersion characteristics from those used in the modeling demonstration, do not result in increases in modeled concentrations and risk the determination that the project does not cause or contribute to a violation of an ambient air quality standard. Tintina shall provide this information within 90 days following start-up of the milling and flotation operation (ARM 17.8.749).

E. Notification

1. Tintina shall supply the Department the following notifications (ARM 17.8.749 and 40 CFR 60, Subpart A and 40 CFR 63, Subpart A):

   a. Date when Aboveground Ore Processing commences construction, postmarked no later than 30 days after such date.

   b. Date when Aboveground Ore Processing including milling and flotation begins operation, postmarked no later than 15 days after such date.

2. Tintina shall provide notification and any documentation, as necessary, from Section II.D.10 within 90 days of start-up of the milling and flotation operation (ARM 17.8.749).

SECTION III: General Conditions

A. Inspection – Tintina shall allow the Department's representatives access to the source at all reasonable times for the purpose of making inspections or surveys, collecting samples, obtaining data, auditing any monitoring equipment such as Continuous Emission Monitoring Systems (CEMS) or Continuous Emission Rate Monitoring Systems (CERMS), or observing any monitoring or testing, and otherwise conducting all necessary functions related to this permit.

B. Waiver – The permit and the terms, conditions, and matters stated herein shall be deemed accepted if Tintina fails to appeal as indicated below.

C. Compliance with Statutes and Regulations – Nothing in this permit shall be construed as relieving Tintina of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*. (ARM 17.8.756).

D. Enforcement – Violations of limitations, conditions and requirements contained herein may constitute grounds for permit revocation, penalties, or other enforcement action as specified in Section 75-2-401, *et seq*., MCA.

E. Appeals – Any person or persons jointly or severally adversely affected by the Department's decision may request, within 15 days after the Department renders its decision, upon affidavit setting forth the grounds therefor, a hearing before the Board of Environmental Review (Board). A hearing shall be held under the provisions of the Montana Administrative Procedures Act. The filing of a request for a hearing does not stay the Department's decision, unless the Board issues a stay upon receipt of a petition and a finding that a stay is appropriate under Section 75-2-211(11)(b), MCA. The issuance of a stay on a permit by the Board postpones the effective date of the Department's decision until conclusion of the hearing and issuance of a final decision by the Board. If a stay is not issued by the Board, the Department's decision on the application is final 16 days after the Department's decision is made.

F. Permit Inspection – As required by ARM 17.8.755, Inspection of Permit, a copy of the air quality permit shall be made available for inspection by the Department at the location of the source.

G. Permit Fee – Pursuant to Section 75-2-220, MCA, failure to pay the annual operation fee by Tintina may be grounds for revocation of this permit, as required by that section and rules adopted thereunder by the Board.

H. Duration of Permit – Construction or installation must begin or contractual obligations entered into that would constitute substantial loss within 3 years of permit issuance and proceed with due diligence until the project is complete or the permit shall expire (ARM 17.8.762).

Montana Air Quality Permit Analysis
Tintina Montana Inc.
MAQP #5200-00

I. Introduction/Process Description

Tintina Montana Inc. (Tintina) proposes to develop and operate an underground copper mine and mill facility. The facility is located approximately 15 miles north of White Sulphur Springs, in Meagher County. The facility is known as the Black Butte Copper Project (BBCP).

A. Permitted Equipment

Point Source Identification at Tintina

Point #	Emitting Unit Name
P1	250 ton per hour (TPH) Portable Conical Crusher
P2	325-horsepower (hp) Portable Diesel Engine/generator
P3	2 Portable Screens (400 TPH each)
P4	131-hp Portable Diesel Engine/generator
P5	545-kilowatt (kW) /914-hp Diesel Engine/generator
P6	320-kW /536-hp Diesel Engine/generator
P7A & P7B	1000-kW /1675-hp Diesel Engine/generators (2) - Emergency
P8	100-hp Diesel Engine/generator - Emergency evac hoists
P9	50-hp Diesel Fire Pump - Emergency
P10A	23 million British thermal unit per hour (MMBtu/hr) Propane-fired heater @ Intake Vent for Upper Copper Zone
P10B	52 MMBtu/hr Propane-fired heater @ Intake Vent for Lower Copper Zone
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)
P12	Jaw Crusher (3640 TPD), Building/Dust Collector
P13A	Mill Building (mill, lime storage, etc.) Dust Collector
P13B	Mill Building (lime area/slurry mix tank) Dust Collector
P14	Surge Bin Discharge Dust Collector
P15	Water Treatment Plant Lime Area Dust Collector
P16A	Backfill Plant Cement/Fly Ash Hopper Dust Filter/Collector
P16B	Backfill Plant Cement/Fly Ash Silo Dust Filter/Collector
P17	Portable diesel engine/generators (total of 400 hp, 4 units)
P18	Air Compressor - Diesel Engine (275 hp)
F26	Diesel-powered Light plants - 11 - 14 hp each, 154 hp total
F27	Gasoline storage tank (double-walled 500 gallon (gal))
F28	9 Temporary portable propane heaters (37.8 MMBtu/hr total)
UG	ANFO

The Point Source table identifies each point source for which an emission inventory was developed and used within the air modeling analysis. Tintina identified the highest emitting rates which occur at each of the emitting units (point sources) over the course of the proposed mine life, and modeled those as if they were occurring at the same time. This approach over-estimated the actual emissions for nearly any given period but also ensures the highest possible rate was used in the modeling demonstration.

It was also necessary to model certain fugitive emissions such as those from haul roads. And while mobile sources are not regulated, underground emissions from blasting and engine emissions are modeled as point sources from the three planned exhaust portals. Fugitive emission sources are shown in the table below.

Fugitive Sources

F1	Road Dust, Mine Operating Year (MOY) 0 to 1
F2	Road Dust, MOY 1 to 2
F3	Road Dust, MOY 2 to 15, Annual Average
F4	Road Dust, MOY 16 and 17, Annual Average
F5	Road Dust, MOY 18
F6	Material Transfer to Temporary Stockpile, MOY 0 to 1.5
F7	Temporary Construction Stockpile
F8	Embankment Construction, MOY 0 to 1.5
F9	Backfill, (NCWR) Embankment Material to Facility CTF MOY 16 to 18
F10	Material Transfer to South Stockpile, MOY 0 to 1
F11	Excess Reclamation Stockpile (South)
F12	Material Transfer from South Stockpile, MOY 16 to 17
F13	Material Transfer to North Stockpile, MOY 0 to 1
F14	Excess Reclamation Stockpile (North)
F15	Material Transfer from North Stockpile, MOY 16 to 18
F16	Soil Removal and Stockpiling, MOY 0 to 1
F17	Topsoil Pile
F18	Subsoil Pile
F19	Soil Return, MOY 16 to 18
F20	Copper-enriched Rock Drop to Stockpile, MOY 2 to 3
F21	Copper-enriched Rock Stockpile (Mill Feed)
F22	Waste Rock Drop at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8
F23	Temporary WRS
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3
F25	Waste Rock Storage Pad Reclamation, MOY 3
F26	11 - 14-hp Portable Diesel-powered Light Plants (only 4 units will be used in Production Phase)
F27	500-gal Gasoline Storage Tank (double-walled)
F28	9 -Temporary Portable Propane-fired Heaters (37.8 MMBtu/hr total) (only 3 will be used in Production Phase)
F29	Road Dust, Construction Access Road, Year 0-2 Avg.
F30	Road Dust, Main Access Road, Year 2-15 Avg.
IEU1	Diesel Storage Tanks (250-gal, 500-gal, 10,000- gal)

B. Source Description

The proposed BBCP will mine approximately 15.3 million tons of copper-enriched rock (CER) and waste rock. This includes 14.5 million tons of CER with an average grade of 3.04% copper and 0.8 million tons of waste rock. Mining will occur at a rate of approximately 1.3 million tons/year or roughly 3,562 tons of CER per day. Ore production permit limits were set to match the highest predicted production level occurring in Year 11 of the mine life. The expected life of the mine is approximately 19 years including: a two-year development phase consisting of construction and pre-production mining, approximately 13 years of active mine production and milling, and four years of reclamation and closure.

Tintina plans to mine CER from the upper and lower Johnny Lee mining zones. The mine permit boundary area is divided into three main property areas near the Sheep Creek Road and Butte Creek Road intersections. The northwest sector contains the mine ventilation raises, while the northeast portion contains an access to a proposed public water supply water well utilized by Tintina. The southern property sector contains all mining operations including the mine portal, milling and material processing facilities, two emergency backup reciprocating internal combustion engine (RICE) gensets, a cemented paste tailings facility, material stockpiles, and various water containment ponds.

A drift and fill method will be used where finely ground mill tailings will be mixed with cement and binder to a form a paste used to backfill production workings. This will allow mining to proceed without the need to leave pillars for structural support. Mined rock will be brought to the surface via haul trucks and processed by vibrating screens and a Portal Crusher located within a crusher building. Material is then conveyed in an enclosed conveyor to the mill building for regrinding and flotation.

C. Response to Public Comments

The Department received a number of comments (17 total) received via the U.S. Mail and also received at the email address specifically set-up to receive electronic comments on the preliminary draft permit. The majority of comments did not address specific air quality permit items and were mostly comments either in favor of, or against the development of the mine. A summary of any substantive comments relative to the air quality concerns is included below along with the Department's response.

Person/Group Commenting	Permit Reference	Comment	Department Response
Trout Unlimited, Colin Cooney and David Brooks	Section II: Conditions and Limitations, subsection B: Emission Control Practice and Requirement	10. Backfill Plant Cement Operations including Fly Ash Hopper and Fly Ash Silo (P16A and P16B) shall use dust filters/collectors for particulate control (ARM 17.8.752). 11. All road sections and all stockpiles (ore, waste rock, excavated bedrock, topsoil, subsoil and temporary construction material	The largest source of particulate matter above-ground will be associated with the short haul road route from the portal to the crusher building. Tintina will also be required to formalize a Fugitive Dust Control Plan which includes all mine areas. Dust collectors will ensure particulate matter is controlled at the Fly Ash Hopper and Fly Ash Silo.

	s, #10 and #11	etc.) shall utilize reasonable precautions for particulate control. For stockpiles, this may include wind-fencing and/or treatment with water or chemical dust suppressant (ARM 17.8.752). Due to the vicinity of the mine, and all its workings including the tailings impoundment, waste rock, use of fly ash etc., in relation to Sheep creek and the surrounding watershed, we stress the highest precautions and strict inspections be taken to minimize impacts from particulate matter to the surrounding watershed. We fear in this case, due to the sensitive area of the proposed mine, reasonable precautions doesn't appropriately describe the measures that need to be taken to protect the surrounding watershed.	Reasonable Precautions through the use of water and/or chemical dust suppressant are required at all sources handing rock screening and crushing facilities. The Department has determined these permit requirements should be adequate to prevent dust events. If after operation begins, the Department determines additional controls are required due to violations; further mitigations would be incorporated through one or more Department mechanisms.
Christopher Policastro	General	This project creates an outsized risk to the environment and should not be approved. Please consider the quality of air, water, and other natural surroundings before the concerns of business. We only have one planet and every step we can take to preserve it is an important one.	This draft air quality permit has identified those conditions which Tintina will need to follow to be protective of ambient air quality. Water and other natural surroundings are addressed in the EIS.
Name Illegible	II.A (General)	The specifics (and broad extent) of the potentially harmful (if not judiciously utilized, monitored and controlled) chemical elements which are an integral part of this Project are, I would judge, well beyond the Public's current awareness or scope, at this juncture. For example, I seriously doubt that the use of "1,552 tons of Ammonium Nitrate Fuel Oil" per year, nearly half-a-million gallons of diesel fuel for just the Underground fueling segment (and the possibilities involved through any leaching of a spill) and the 4.2 Million gallons of propane ... all are merely 'operational Essentials' to the day-by-day duties of this Project. Not just such Volumes, but the potential toxicity of any mishaps in just this small portion of	The Department's Field Services staff would be responsible for site visits to determine compliance with the permit conditions. Secondly, as a stationary source, Tintina would be submitting annual emission inventory information for review by the Department. The Department believes the permit conditions, if followed, will be protective of ambient air quality.

		elements (and there are another eight – 8 - more of near equal concern) should require 'Pause'. Who will monitor these amounts and how they are stored /controlled/securely used and accounted for?	

D. Response to Tintina Comments

Permit Reference	Comment (Summarized by Department)	Department Response
II.A.1	The condition incorrectly applies the daily limit on copper enriched rock to P1 (referred to as the "portal crusher"), a portable crusher that is associated with the development phase at the mine. As described in Appendix A of the April 20, 2018, ·revision of the MAQP Application, P1 will process waste rock in the development phase of the mine, not copper-enriched rock throughout the production phase. In addition, P1 was permitted for up to 250 tons per hour (TPH) of that waste rock, which would equate to 6000 tons per day, not 3,700. The daily throughput capacity of mining operations can vary +/- 20% every day due a variety of circumstances from hard ore to equipment availability. This variability can also apply to the annual numbers. The annual production estimate of 1.35 million tons of copper-enriched rock (from which the 3,700 tons per day appears to have come from) is an annual anticipated average over the production life of the mine. Tintina needs the flexibility to increase throughput if the previous day, week, month or year has had issues that prevented it from operating at full capacity. BBCP will not cause or contribute to a violation of the ambient air quality standards given the existing analysis that is based on equipment operating at a full potential to emit, not on a specific production level.	The Department misunderstood that the portal crusher was only planned to be operational during the development phase of the mine. Therefore, the Department has revised the limit to reflect the 6000 tons per day and revised the limit to reflect a rolling 12-month limit of 2.19 million tons per year of waste rock.
II.A.2	Like Condition II.A.1, the condition incorrectly applies the annual limit on copper-enriched rock to P1 (referred to as the "portal crusher"). P1 is a portable crusher that is associated with the development phase at the mine. As described in Appendix A of the April 20, 2018, revision of the MAQP Application, P1 will process waste rock in the development phase of the mine, not copper-enriched rock throughout the production phase. In addition, P1 was permitted for up to 250 TPH of that waste rock, resulting in 2.19 million tons per year of waste rock processed, not the 1.35 million tons of copper-enriched rock described.	The Department has reviewed the need for a daily limit and determined that a rolling 12-month limit will be protective of ambient air quality standards for particulate matter. The Department has reviewed the information and determined a given year may have more production than the earlier estimate which was based on average annual production and determined 1.46 million tons per

	Also, like Condition II.A.1, the annual production estimate of 1.35 million tons of copper enriched is an anticipated annual average over the production life of the mine and was never intended. to limit the operations. The mine needs flexibility to improve the financial position of the company. Tintina also needs the flexibility to increase throughput if the previous day, week, month or year has had issues that prevented it from operating at full capacity. As discussed above, the daily throughput capacity of mining operations can vary +/- 20% due a variety of circumstances from hard ore to equipment availability. This variability also applies to the annual numbers. With respect to measurement of a potential production limit, Tintina requests this condition be updated to apply to the weight meter following the coarse ore bin (COB) instead of P1.	year as a 12-month rolling limit that will still be protective of ambient air quality. The location for measurement has been modified to reflect the weight meter following the coarse ore bin.
II.A.5	Tintina requests removal of unit P1 from the listing in the condition. The condition addresses diesel-fired generator sets. P1 is a portable crusher and while it is associated with a diesel-fired generator, that generator is listed separately as P2 and is already included in the condition. The corrected hp rating for the nonemergency engines should be "not to exceed" 2735 hp.	The Department has corrected the condition to remove P1 and revise the hp rating to 2,735 hp.
II.A.6	Tintina requests deletion of this limit. This issue is well covered in the overall facility diesel fuel limit in Condition II.A.7. As the Department is aware, the underground emissions are almost exclusively comprised of mobile source emissions.	The Department agrees that this limit is effectively already included within II.A.7, and opted not to incorporate a specific permit condition requiring testing on the exhaust portals. However, the Department could require source testing in the future, if determined to be necessary.
II.A.13	Tintina requests the reference to Section II.A.10 be changed to reflect the "reasonable precautions" condition of Section II.A.12.	Corrected as requested.
II.A.15	Tintina requests the term "baghouses" be replaced with "dust collectors" which is consistent with Condition II.B.9 and the BACT analysis for these units.	Revised as requested.
II.A.20	Tintina requests "P7" be replaced with "P7A and P7B" to be consistent with Conditions II.A.16 and 17.	Revised as requested.
II.B.3	Tintina assumes this condition was meant to address P1 - 250- TPH Portable Conical Crusher and P3 - Two Portable Screens (400 TPH each), and requests the condition language be changed to "Portable crusher and screens (P1 and P3) ... "	Revised as requested.
II.B.4	Tintina requests units P7, P8, and P9, the emergency engines, be removed from this condition. Those units are already identified as	Revised as requested.

	being subject to 40 60, Subpart LLLL in Condition II.A 16.	
II.B.8	This condition is unnecessary because it already exists in federal law. Ultra-low sulfur diesel (diesel limited to 15 parts per million sulfur by weight) is the only diesel fuel available for purchase for on-road and nonroad vehicles pursuant to EPA's diesel in fuel regulations that were fully in effect nationwide after 2014 (see EPA's diesel fuel· regulations at 40 CFR 80, Subpart I.	Revised as requested.
II.D.1.a	Tintina requests this be updated to reflect measurement at the weight meter following the COB.	Revised as requested.
II.D.1.b	On the basis of the comment on Condition II.A.6, Tintina requests this condition be removed.	Revised as requested.
II.D.1.c	There is no corresponding condition to track diesel fuel used by above-ground equipment. Tintina requests this condition be removed.	Condition II.D.1.c has been modified to reflect a site wide tracking of diesel fuel usage to address II.A.6.
II.D.5	See discussion on the corresponding Condition II.A 1.	Condition was modified to reflect an annual limit. See new II.A.1.
II.D.6	See discussion on the corresponding Condition II.A.2 with respect to location of measurement and the inapplicability of the limit to the Portal Crusher (P1).	Revised accordingly.
II.D.9	See discussion on the corresponding Condition II.A.6. Tintina requests deletion of this requirement.	Incorporated.
II.D.10	This condition references "underground equipment" and appears to be identical to Condition II.D.9. Tintina requests this condition be updated to reflect Condition II.D.7.	Revised.
Permit Analysis Section II.F	Tintina submitted· an affidavit of publication for the February 20, 2018, issue of the Helena Independent Record, a newspaper of general circulation in the area affected by the permit, in addition to those newspapers listed. Tintina requests this affidavit also be included in the notification list.	Revised.
Permit Analysis, Section IV	Tintina requests correction of the horsepower (hp) rating on unit P6 in the first table listing the emitting units. The correct hp rating is 536-hp, as listed in Section I.A of the permit analysis.	Revised.
Permit Analysis, Section IV	Tintina requests a clarifying comment associated with the total in the last table of that section listing the fugitive source PM totals. The total indicated covers emissions from multiple mine operating years that would not coincide; therefore, the "total" is not representative of actual mine operation in any one annual period.	The total was removed and the Department will let the individual fugitive IDs and the year of emissions represent the emissions for their respective periods.

II. Applicable Rules and Regulations

The following are partial explanations of some applicable rules and regulations that apply to the facility. The complete rules are stated in the Administrative Rules of Montana (ARM) and are available, upon request, from the Department of Environmental Quality (Department). Upon request, the Department will provide references for location of complete copies of all applicable rules and regulations or copies where appropriate.

A. ARM 17.8, Subchapter 1 – General Provisions, including but not limited to:

1. ARM 17.8.101 Definitions. This rule includes a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.105 Testing Requirements. Any person or persons responsible for the emission of any air contaminant into the outdoor atmosphere shall, upon written request of the Department, provide the facilities and necessary equipment (including instruments and sensing devices) and shall conduct tests, emission or ambient, for such periods of time as may be necessary using methods approved by the Department.

3. ARM 17.8.106 Source Testing Protocol. The requirements of this rule apply to any emission source testing conducted by the Department, any source or other entity as required by any rule in this chapter, or any permit or order issued pursuant to this chapter, or the provisions of the Clean Air Act of Montana, 75-2-101, *et seq*., Montana Code Annotated (MCA).

   Tintina shall comply with the requirements contained in the Montana Source Test Protocol and Procedures Manual, including, but not limited to, using the proper test methods and supplying the required reports. A copy of the Montana Source Test Protocol and Procedures Manual is available from the Department upon request.

4. ARM 17.8.110 Malfunctions. (2) The Department must be notified promptly by telephone whenever a malfunction occurs that can be expected to create emissions in excess of any applicable emission limitation or to continue for a period greater than 4 hours.

5. ARM 17.8.111 Circumvention. (1) No person shall cause or permit the installation or use of any device or any means that, without resulting in reduction of the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant that would otherwise violate an air pollution control regulation. (2) No equipment that may produce emissions shall be operated or maintained in such a manner as to create a public nuisance.

B. ARM 17.8, Subchapter 2 – Ambient Air Quality, including, but not limited to the following:

1. ARM 17.8.204 Ambient Air Monitoring
2. ARM 17.8.210 Ambient Air Quality Standards for Sulfur Dioxide
3. ARM 17.8.211 Ambient Air Quality Standards for Nitrogen Dioxide

4. ARM 17.8.212 Ambient Air Quality Standards for Carbon Monoxide
5. ARM 17.8.213 Ambient Air Quality Standard for Ozone
6. ARM 17.8.214 Ambient Air Quality Standard for Hydrogen Sulfide
7. ARM 17.8.220 Ambient Air Quality Standard for Settled Particulate Matter
8. ARM 17.8.221 Ambient Air Quality Standard for Visibility
9. ARM 17.8.222 Ambient Air Quality Standard for Lead
10. ARM 17.8.223 Ambient Air Quality Standard for PM_{10}
11. ARM 17.8.230 Fluoride in Forage

Tintina must maintain compliance with the applicable ambient air quality standards.

C. ARM 17.8, Subchapter 3 – Emission Standards, including, but not limited to:

1. ARM 17.8.304 Visible Air Contaminants. This rule requires that no person may cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

2. ARM 17.8.308 Particulate Matter, Airborne. (1) This rule requires an opacity limitation of less than 20% for all fugitive emission sources and that reasonable precautions be taken to control emissions of airborne particulate matter. (2) Under this rule, Tintina shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter.

3. ARM 17.8.309 Particulate Matter, Fuel Burning Equipment. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter caused by the combustion of fuel in excess of the amount determined by this rule.

4. ARM 17.8.310 Particulate Matter, Industrial Process. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter in excess of the amount set forth in this rule.

5. ARM 17.8.322 Sulfur Oxide Emissions--Sulfur in Fuel. This rule requires that no person shall burn liquid, solid, or gaseous fuel in excess of the amount set forth in this rule.

6. ARM 17.8.324 Hydrocarbon Emissions--Petroleum Products. (3) No person shall load or permit the loading of gasoline into any stationary tank with a capacity of 250 gallons or more from any tank truck or trailer, except through a permanent submerged fill pipe, unless such tank is equipped with a vapor loss control device as described in (1) of this rule.

7. ARM 17.8.340 Standard of Performance for New Stationary Sources and Emission Guidelines for Existing Sources. This rule incorporates, by reference, 40 CFR Part 60, Standards of Performance for New Stationary Sources (NSPS). Tintina is considered an NSPS affected facility under 40 CFR Part 60 and is subject to the requirements of the following subparts.

a. 40 CFR 60, Subpart A – General Provisions apply to all equipment or facilities subject to an NSPS Subpart as listed below:

b. 40 CFR 60, Subpart LL – Standard of Performance for Metallic Mineral Processing Plants.

c. 40 CFR 60, Subpart IIII – Standard of Performance for Stationary Compression Ignition Internal Combustion Engines. Owners and operators of stationary CI ICE that commence construction after July 11, 2005, where the stationary CI ICE are manufactured after April 1, 2006, and are not fire pump engines, and owners and operators of stationary CI ICE that modify or reconstruct their stationary CI ICE after July 11, 2005, are subject to this subpart. Based on the information submitted by Tintina, the CI ICE equipment to be used under MAQP #5200-00 may be subject to this subpart because the proposed engines are manufactured after the applicable date.

10. ARM 17.8.342 Emission Standards for Hazardous Air Pollutants for Source Categories. The source, as defined and applied in 40 CFR Part 63, shall comply with the requirements of 40 CFR Part 63, as listed below:

a. 40 CFR 63, Subpart A – General Provisions apply to all equipment or facilities subject to an NESHAP Subpart as listed below:

b. 40 CFR 63, Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. An owner or operator of a stationary reciprocating internal combustion engine (RICE) at a major or area source of HAP emissions is subject to this rule except if the stationary RICE is being tested at a stationary RICE test cell/stand. An area source of HAP emissions is a source that is not a major source. Based on the information submitted by Tintina, the RICE equipment to be used under MAQP #5200-00 may be subject to this subpart if Tintina remains in the same location for more than 12 months.

c. 40 CFR 63, Subpart CCCCCC – National Emissions Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities.

D. ARM 17.8, Subchapter 4 – Stack Height and Dispersion Techniques, including, but not limited to:

1. ARM 17.8.401 Definitions. This rule includes a list of definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.402 Requirements. Tintina must demonstrate compliance with the ambient air quality standards with a stack height that does not exceed Good Engineering Practices (GEP). The proposed height of all stacks for Tintina is below the allowable 65-meter GEP stack height.

E. ARM 17.8, Subchapter 5 – Air Quality Permit Application, Operation, and Open Burning Fees, including, but not limited to:

1. ARM 17.8.504 Air Quality Permit Application Fees. This rule requires that an applicant submit an air quality permit application fee concurrent with the submittal of an air quality permit application. A permit application is incomplete until the proper application fee is paid to the Department. Tintina submitted the appropriate permit application fee for the current permit action.

2. ARM 17.8.505 Air Quality Operation Fees. An annual air quality operation fee must, as a condition of continued operation, be submitted to the Department by each source of air contaminants holding an air quality permit (excluding an open burning permit) issued by the Department. The air quality operation fee is based on the actual or estimated actual amount of air pollutants emitted during the previous calendar year.

   An air quality operation fee is separate and distinct from an air quality permit application fee. The annual assessment and collection of the air quality operation fee, described above, shall take place on a calendar-year basis. The Department may insert into any final permit issued after the effective date of these rules, such conditions as may be necessary to require the payment of an air quality operation fee on a calendar-year basis, including provisions that prorate the required fee amount.

F. ARM 17.8, Subchapter 7 – Permit, Construction, and Operation of Air Contaminant Sources, including, but not limited to:

1. ARM 17.8.740 Definitions. This rule is a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.743 Montana Air Quality Permits--When Required. This rule requires a person to obtain an air quality permit or permit modification to construct, modify, or use any air contaminant sources that have the potential to emit (PTE) greater than 25 tons per year of any pollutant. Tintina has a PTE greater than 25 tons per year of particulate matter (PM), particulate matter with an aerodynamic diameter less than or equal to ten microns (PM10), oxides of nitrogen (NOx), carbon monoxide (CO) and volatile organic compounds (VOCs), and therefore, an air quality permit is required.

3. ARM 17.8.744 Montana Air Quality Permits--General Exclusions. This rule identifies the activities that are not subject to the Montana Air Quality Permit program.

4. ARM 17.8.745 Montana Air Quality Permits--Exclusion for De Minimis Changes. This rule identifies the de minimis changes at permitted facilities that do not require a permit under the Montana Air Quality Permit Program.

5. ARM 17.8.748 New or Modified Emitting Units--Permit Application Requirements. (1) This rule requires that a permit application be submitted

prior to installation, modification, or use of a source. Tintina submitted the required permit application for the current permit action. (7) This rule requires that the applicant notify the public by means of legal publication in a newspaper of general circulation in the area affected by the application for a permit. Tintina submitted an affidavit of publication of public notice for the February 20, 2018, issue of the *Bozeman Chronicle*, a newspaper of general circulation in the Town of Bozeman in Gallatin County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 20, 2018, issue of the *Great Falls Tribune*, a newspaper of general circulation in the Town of Great Falls in Cascade County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 22, 2018, issue of the *Meagher County News*, a newspaper of general circulation in the Town of White Sulphur Springs in Meagher County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 20, 2018, issue of the *Helena Independent Record*, a newspaper of general circulation in the Town of Helena in Lewis and Clark Count, as proof of compliance with the public notice requirements.

6. ARM 17.8.749 Conditions for Issuance or Denial of Permit. This rule requires that the permits issued by the Department must authorize the construction and operation of the facility or emitting unit subject to the conditions in the permit and the requirements of this subchapter. This rule also requires that the permit must contain any conditions necessary to assure compliance with the Federal Clean Air Act (FCAA), the Clean Air Act of Montana, and rules adopted under those acts.

7. ARM 17.8.752 Emission Control Requirements. This rule requires a source to install the maximum air pollution control capability that is technically practicable and economically feasible, except that BACT shall be utilized. The required BACT analysis is included in Section III of this permit analysis.

8. ARM 17.8.755 Inspection of Permit. This rule requires that air quality permits shall be made available for inspection by the Department at the location of the source.

9. ARM 17.8.756 Compliance with Other Requirements. This rule states that nothing in the permit shall be construed as relieving Tintina of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*.

10. ARM 17.8.759 Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those permit applications that do not require the preparation of an environmental impact statement.

11. ARM 17.8.760 Additional Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications

and making permit decisions on those applications that require an environmental impact statement.

12. ARM 17.8.762 Duration of Permit. An air quality permit shall be valid until revoked or modified, as provided in this subchapter, except that a permit issued prior to construction of a new or modified source may contain a condition providing that the permit will expire unless construction is commenced within the time specified in the permit, which in no event may be less than 1 year after the permit is issued.

13. ARM 17.8.763 Revocation of Permit. An air quality permit may be revoked upon written request of the permittee, or for violations of any requirement of the Clean Air Act of Montana, rules adopted under the Clean Air Act of Montana, the FCAA, rules adopted under the FCAA, or any applicable requirement contained in the Montana State Implementation Plan (SIP).

14. ARM 17.8.764 Administrative Amendment to Permit. An air quality permit may be amended for changes in any applicable rules and standards adopted by the Board of Environmental Review (Board) or changed conditions of operation at a source or stack that do not result in an increase of emissions as a result of those changed conditions. The owner or operator of a facility may not increase the facility's emissions beyond permit limits unless the increase meets the criteria in ARM 17.8.745 for a de minimis change not requiring a permit, or unless the owner or operator applies for and receives another permit in accordance with ARM 17.8.748, ARM 17.8.749, ARM 17.8.752, ARM 17.8.755, and ARM 17.8.756, and with all applicable requirements in ARM Title 17, Chapter 8, Subchapters 8, 9, and 10.

15. ARM 17.8.765 Transfer of Permit. This rule states that an air quality permit may be transferred from one person to another if written notice of intent to transfer, including the names of the transferor and the transferee, is sent to the Department.

G. ARM 17.8, Subchapter 8 – Prevention of Significant Deterioration of Air Quality, including, but not limited to:

1. ARM 17.8.801 Definitions. This rule is a list of applicable definitions used in this subchapter.

2. ARM 17.8.818 Review of Major Stationary Sources and Major Modifications--Source Applicability and Exemptions. The requirements contained in ARM 17.8.819 through ARM 17.8.827 shall apply to any major stationary source and any major modification, with respect to each pollutant subject to regulation under the FCAA that it would emit, except as this subchapter would otherwise allow.

This facility is not a major stationary source because this facility is not a listed source and the facility's PTE is below 250 tons per year of any pollutant (excluding fugitive emissions).

H. ARM 17.8, Subchapter 12 – Operating Permit Program Applicability, including, but not limited to:

1. ARM 17.8.1201 Definitions. (23) Major Source under Section 7412 of the FCAA is defined as any source having:

   a. PTE > 100 tons/year of any pollutant;

   b. PTE > 10 tons/year of any one hazardous air pollutant (HAP), PTE > 25 tons/year of a combination of all HAPs, or lesser quantity as the Department may establish by rule; or

   c. PTE > 70 tons/year of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) in a serious PM_{10} nonattainment area.

2. ARM 17.8.1204 Air Quality Operating Permit Program. (1) Title V of the FCAA amendments of 1990 requires that all sources, as defined in ARM 17.8.1204(1), obtain a Title V Operating Permit. In reviewing and issuing MAQP #5200-00 for Tintina, the following conclusions were made:

   a. The facility's PTE is greater 100 tons/year for CO and NO_x during the development phase when the use of temporary equipment would be needed.

   b. The facility's PTE is less than 10 tons/year for any one HAP and less than 25 tons/year for all HAPs.

   c. This source is not located in a serious PM_{10} nonattainment area.

   d. This facility is subject to NSPS 40 CFR 60, Subpart LL and Subpart IIII.

   e. This facility is subject to NESHAP 40 CFR 63, Subpart ZZZZ and Subpart CCCCCC.

   f. This source is not a Title IV affected source, or a solid waste combustion unit.

   g. This source is not an EPA designated Title V source.

   Based on these facts, the Department determined that Tintina is subject to the Title V operating permit program. Tintina has indicated they will apply for a Title V operating permit as required unless they prepare an updated MAQP application during the development phase to reduce their emissions below Title V thresholds.

III. BACT Determination

A BACT determination is required for each new or modified source. Tintina shall install on the new or modified source the maximum air pollution control capability which is technically practicable and economically feasible, except that BACT shall be utilized.

A BACT analysis was submitted by Tintina in permit application #5200-00, addressing available methods of controlling emissions from the proposed BBCP. The Department reviewed these methods, as well as previous BACT determinations. The following control options have been reviewed by the Department in order to make the following BACT determination.

BACT for Particulate Matter Emissions from Mineral Handling and Processing (jaw crusher, surge bin, mill building processes) and Auxiliary Processing and Handling (backfill plant, water treatment plant lime storage)

The mineral handling includes a jaw crusher, surge bin, and ore processing/milling. The auxiliary processing includes the backfill plant and the water treatment plant lime storage. These sources are individual emissions sources but are considered as a group with respect to particulate control technology evaluation.

Of the list of regulated criteria pollutants, these sources emit particulates (PM, PM_{10}, and $PM_{2.5}$). The analyses presented here are restricted to evaluation of BACT for the product processing and handling.
Note: Conveyors used in ore processing are enclosed and as a result do not require further analysis.

Step 1 - Identify All Control Options

The table below briefly describes available technologies for controlling particulate emissions from product processing and handling.

Available Particulate Control Technologies

Technology	**Description**
No Add-on Control	This is the base case for proposed new sources.
Enclosure	Enclosure technology employs structures, devices or underground placement to shelter material from wind entrainment. Enclosures can either fully or partially surround the source.
Wet Dust Suppression Including Retained or Inherent Moisture	Fogging water spray adds water, with or without surfactant, to material. Emissions are reduced through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. Moisture retained from water sprays upstream in the process or moisture inherent in the material provides a similar emission reducing effect.
Electrostatic Precipitator (ESP)	An ESP uses electrical forces to move entrained particles onto a collection surface. To remove dust cake from the collection surface, the collection surface is periodically "rapped" by a variety of means to dislocate the particulate, which drops down into a hopper. Particulate-laden air must be able to be collected and ducted to the ESP.

Technology	Description
Wet Particulate Scrubber	Wet scrubbers typically use water to impact, intercept, or diffuse a particulate in a waste gas stream. Particulate matter is accelerated and impacted onto a solid surface or into a liquid droplet through devices such as a venturi and spray chamber. Wet slurry material is typically stored in an on-site waste impoundment.
Fabric Filter Dust Collector/Bin Vent/Baghouse	Fabric filter dust collectors/bin vents/baghouses direct particulate- laden exhaust through tightly woven or felted fabric that traps particulate by sieving and other mechanisms. Collection efficiency and pressure drop simultaneously increase as a particulate layer collects on the filter. Filters are intermittently cleaned by shaking the bag, pulsing air through the bag, or temporarily reversing the airflow direction.

Step 2 - Eliminate Technically Infeasible Options

Wet Scrubber

Wet scrubbers can be very effective for particulate control; however, wet scrubbers would create a waste stream for disposal and are very seldom used on processes of this small size due to their complex operation, large footprint, and heavy use of water resources. For these reasons, a wet particulate scrubber as a control technology would be considered technically infeasible and not available to control particulate emissions from the mineral handling and processing.

Electrostatic Precipitators

Although ESP units are theoretically capable of controlling particulate emissions at levels similar to baghouses, they are generally not feasible for the application considered here. The EPA Air Pollution Cost Manual states that, “ESPs are not typically viewed as cost effective control devices for smaller sources” (U.S. EPA, 2002, pp. 4-15). Further, EPA states in another technical report that, "Electrostatic precipitators are usually not suited for use on processes which are highly variable, since frequent changes in operating conditions are likely to degrade ESP performance" (U.S. EPA, 1998). Tintina indicated it is unaware of any application of an ESP to control fugitive particulate emitted during mineral processing/handling or auxiliary processing/handling. For these reasons, ESP technology is considered to be technically infeasible and not available to control particulate emissions from the product processing and handling.

Step 3 - Rank Remaining Options by Control Effectiveness

The remaining available alternatives according to their respective potential effectiveness values.

Technology	Control Efficiency	Ranking
Fabric Filter Bin Vent/Dust Collector/Baghouse	95-99.9+%	1
Enclosure	Up to 90% (varies with degree of enclosure)	2
Wet Dust Suppression	50%	3
No Add-on Control	Base case	4

Step 4 - Evaluate Most Effective Controls and Document Results

Tintina proposes to install the top ranked control technology, fabric filter dust collector, to control particulate emissions from the mineral and auxiliary processing and handling points. Additional control will be provided by building enclosures for the jaw crusher, milling processes, backfill plant, and water treatment lime silo.

Step 5 - Select BACT

Based upon the preceding analysis, Tintina proposes that fabric filter dust collectors with a grain loading limit of 0.01 gr PM (with respect to filterable emissions, the manufacturer uses the conservative approach of equating PM_{10} and $PM_{2.5}$ emissions with PM) as BACT. The grain loading value is consistent with recent MDEQ-permitted small dust collectors installed in Montana. Larger processes provide for smaller air-to-cloth ratio; i.e., more filtration available for a unit amount of exhaust flow. The Texas Commission on Environmental Quality publishes current guidelines for Bulk Material Handling which indicate that fabric filter baghouses with 0.01 gr/dscf grain loading specifications (approx. 99% reduction) constitute BACT for those types of sources.

BACT for Gaseous and Particulate Emissions from Diesel Engines/Generators

Tintina is proposing to use a variety of diesel engines/generators from light plants powered by 14-hp diesel engines to 1,000-kilowatt emergency backup generators. All of these are subject to EPA non-road engine standards, as described in 40 CFR Part 89 and/or 1039, as well as NSPS Subpart IIII for RICE. BACT for these engines is compliance with EPA nonroad standards and NSPS Subpart IIII. The proposed BACT conforms to previous BACT determinations made by MDEQ for similar-sized diesel engines. With respect to using the most recent (and lowest emitting) engines available, 40 CFR 60.4208 requires owners and operators to install recently manufactured engines that meet the NSPS standards.

BACT for Gaseous and Particulate Emissions from Propane Heaters (23 MMBtu/hr and 52 MMBtu/hr each)

Tintina is proposing to use two direct-fired propane heaters (one 23 MMBtu/hr and one 52 MMBtu/hr) at each intake vent to heat air entering the mine. Of the list of regulated criteria pollutants, these sources emit both gaseous and particulate emissions. The BACT analyses is broken down in two categories for add-on control: CO/VOC and NOx. Particulate matter emissions from cleaning burning fuels such as propane are quite small and would be best controlled by good combustion practices. SO_2 emissions are negligible and result solely from the sulfur content of propane.

Step 1 - Identify All Control Options – CO/VOC

CO and VOC are formed from the incomplete combustion of organic constituents in propane. Because CO and VOC are generated and controlled by the same mechanisms, they are addressed together. Two general and nonexclusive approaches were analyzed for controlling these emissions: improving combustion conditions to facilitate complete combustion in the heater burner and completing oxidation of the exhaust stream after it leaves the heater burner. Post-combustion CO/VOC control is accomplished via add-on equipment that creates an environment of high temperature and oxygen concentration to promote complete oxidation of the CO and VOC remaining in the exhaust. This can be facilitated at relatively low temperatures by the use of certain catalyst materials.

Technology	Description
Proper system design and operation	The base level of emissions for CO and VOC is proper design and operation of the proposed heater without additional add-on control. The CO and VOC emissions can be minimized by controlling the system temperatures through operation at maximum loads; increasing oxygen concentrations; maximizing combustion residence time; and improving mixing of the fuel, exhaust gases, and combustion air. Generally, a reduction in CO and VOC emissions will result in an increase in NOx emissions.
Thermal oxidation	Thermal oxidizers are essentially supplementary chambers that complete the fuel combustion of unburned organic constituents. They accomplish this by creating a high temperature environment with optimal oxygen concentration, mixing, and residence time. They require temperatures of approximately 1400 degrees Fahrenheit (°F) to 1500°F. This high temperature environment is produced by the combustion of supplemental fuel. Several design variations address different inlet concentrations, air flow rates, fuel efficiency requirements, and other operational variables. All of them function using the basic principles described above. One commonly used design is called a regenerative thermal oxidizer (RTO) which is evaluated for this BACT analysis. RTOs are capable of reducing CO and VOC emissions by 95 to 99 percent.
Catalytic oxidation	Catalytic oxidizers employ the same principles as thermal oxidizers, but they use catalysts to lower the temperature required to affect complete oxidation. One commonly used design is called a regenerative catalytic oxidizer (RCO) which is evaluated for this BACT analysis. The optimum temperature range for catalytic oxidizers is generally about 800°F. Catalytic oxidizers must be located downstream of a PM control device if the exhaust stream contains appreciable concentrations of PM because catalysts are prone to plugging and poisoning. For this application, the portal heater would be combusting a clean fuel (propane) and PM loading is not anticipated to be a problem. Like thermal oxidizers, catalytic oxidizer designs include many varieties to address specific operational conditions and requirements. They are generally capable of 90 to 99 percent destruction or removal efficiency at steady-state conditions.

Step 2 - Eliminate Technically Infeasible Options – CO/VOC

The proposed portal heaters are direct-fired burners where the combustion exhaust gases and the heated air are inseparable. This configuration makes the installation of the add-on pollution control equipment addressed here technically infeasible. The remaining option is proper system design and operation.

Step 3 - Rank Remaining Options by Control Effectiveness – CO/VOC

Proper design and operation was determined to be the only technically feasible control option for the portal heaters.

Step 4 - Evaluate Most Effective Controls and Document Results – CO/VOC

Proper design and operation was determined to be the only technically feasible control option for the portal heater.

Step 5 - Select BACT – CO/VOC

Tintina proposes that proper design and operation of the two propane-fired vent heaters are BACT for CO and VOC. The combustion of a clean fuel (propane) and following good combustion practices is proposed as BACT for the heaters associated with this project. The proposed BACT conforms to previous BACT determinations made by MDEQ.

BACT for NO_x for the Two Propane-Fired Heaters

Step 1 - Identify All Control Options – NO_x

NO_x is formed during propane combustion in the heater. NO_x comes from two sources in combustion, fuel NO_x and thermal NO_x. The fuel NO_x portion is relatively small and is based almost solely on the type of fuel combusted. The majority of NO_x formation is dominated by the process called thermal NO_x formation. Thermal NO_x results from the thermal fixation of atmospheric nitrogen and oxygen in the combustion air. The rate of formation is sensitive to local flame temperature and, to a lesser extent, local oxygen concentrations. Virtually all thermal NO_x is formed in the region of the flame at the highest temperature. Maximum thermal NO_x production occurs at a slightly lean fuel-to-air ratio due to the excess availability of oxygen for reaction with the nitrogen in the air and fuel. The following table contains NO_x control technologies for heaters.

Technology	**Description**
Proper system design and operation	The base level of emissions for NOx is proper design and operation of the proposed heater without additional add-on control.
Low NO_x Burners with Flue Gas Recirculation	Due to limited success of Low NO_x Burners (LNB) in lowering NO_x emissions as a stand-alone technology, it has been integrated with Flue Gas Recirculation (FGR). Together, LNB and FGR integrate staged combustion into the burner creating a fuel-rich primary combustion zone. Fuel NO_x formation is decreased by the reducing conditions in the primary combustion zone. Thermal NO_x is limited due to the lower flame temperature caused by the lower oxygen concentration. The secondary combustion zone is a fuel-lean zone where combustion is completed. The combined technology may result in increased CO and hydrocarbon emissions, decreased boiler efficiency and increased fuel costs.
Selective Non-Catalytic Reduction	Selective Non-Catalytic Reduction involves the noncatalytic decomposition of NO_x in the flue gas to nitrogen and water using a reducing agent (e.g., ammonia or urea). The reactions take place at much higher temperatures than in an SCR, typically between 1,650°F and 2100°F, because a catalyst is not used to drive the reaction. The efficiency of the conversion process diminishes quickly when operated outside the optimum temperature band and additional ammonia slip or excess NO_x emissions may result.

Technology	Description
Selective Catalytic Reduction	Selective Catalytic Reduction (SCR) is a post-combustion gas treatment technique for reduction of NO and NO_2 in an exhaust stream to molecular nitrogen, water, and oxygen. Ammonia (NH_3) or urea is used as the reducing agent. Ammonia or urea is injected into the flue gas upstream of a catalyst bed, and NO_X and NH_3 combine at the catalyst surface, forming an ammonium salt intermediate, which subsequently decomposes to produce elemental nitrogen and water. The control technology works best for flue gas temperatures between 575°F and 750°F. Excess air is injected at the heater exhaust to reduce temperatures to the optimum range, or the SCR is located in a section of the heater exhaust ducting where the exhaust temperature has cooled to this temperature range.

Step 2 - Eliminate Technically Infeasible Options – NO_x

The proposed portal heaters are direct-fired burners where the combustion exhaust gases and the heated air are inseparable. This configuration makes the practical installation of the FGR as well as add-on pollution control equipment addressed here technically infeasible. The remaining option is proper system design and operation.

Step 3 - Rank Remaining Options by Control Effectiveness – NO_x

Proper design and operation was determined to be the only technically feasible control option for the portal heaters.

Step 4 - Evaluate Most Effective Controls and Document Results – NO_x
Proper design and operation was determined to be the only technically feasible control option for the portal heater.

Step 5 - Select BACT - NO_x

Tintina proposes that proper design and operation of the two propane-fired vent heaters are BACT for NO_x. The combustion of a clean fuel (propane) and following good combustion practices is proposed as BACT for the heaters associated with this project. The proposed BACT conforms to previous BACT determinations made by MDEQ.

BACT for Gaseous and Particulate Emissions from Small, Temporary, Portable Propane (nine heaters, 37.8 MMBtu/hr total) and Diesel Heaters (three heaters, 1.2 MMBtu/hr total)

Tintina proposes to use temporary heaters during the development phase for worker safety and to heat mine intake air, as necessary. The BACT analysis regarding the temporary diesel heaters in use at the portal and the temporary portable propane heaters that will be moved site-wide has been combined to assess BACT for small clean-burning heaters. Based on the small size of the heaters and the minimal emissions generated, particularly as temporary units, no add-on control technology would be economically feasible. Emissions of all criteria pollutants will be minimized through the combustion of propane and diesel and by following good combustion practices for these units.

Good combustion practices are proposed as BACT for the small, portable, temporary heaters associated with this project which burn both propane and diesel. The proposed BACT conforms to previous BACT determinations made by MDEQ for similar-sized propane and diesel heaters.

BACT for Particulate Emissions from Small Crushers and Screens (250 TPH crusher and two 400-TPH screens)

PM emissions are created by crushing and screening equipment. The potential uncontrolled emissions of particulate matter emissions from these operations can be significant. The moisture content of the material processed can have a substantial effect on emissions. Surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger stones, with a resulting dust suppression effect. However, as new fine particles are created by crushing and attrition and as the moisture content is reduced by evaporation, this suppressive effect diminishes. Operators that use wet suppression systems (spray nozzles) to maintain material moisture as needed can effectively control PM emissions throughout the process. Therefore, Tintina proposes wet suppression as BACT for the control of PM emissions on the small, portable crushing and screening units.

BACT for Gaseous and Particulate Emissions from Explosives Detonation/Blasting Ammonium Nitrate Fuel Oil (ANFO)

Explosives (primarily ANFO) will be used for underground mining and will result in the release of gaseous (NO_2, SO_2, and CO) and particulate (PM, PM_{10}, and $PM_{2.5}$) emissions. ANFO is a common bulk industrial explosive mixture that accounts for roughly 80% of explosives used annually in North America. The mixture provides a reliable explosive that is relatively easy to use, highly stable until detonation, and low cost. Gaseous emissions will result from the detonation of the chemical compounds with the explosives. Particulate emissions will result from the blasting and loosening of ore material. While blasting seemingly generates large amounts of dust, the operation occurs infrequently enough that it is not considered to be a significant contributor of PM_{10} [EPA 1991; Richards and Brozell 2001]. Nonetheless, various best operational practices (BOPs) and blasting techniques will be utilized for reducing gaseous and particulate emissions from blasting.

Tintina will use the following blasting BOPs:

- Optimize drill-hole size. Optimizing drill-hole size will result in effective blasting and reduce the number of blasts needed to achieve the desired effect.

- Optimize drill hole placement and utilization of sequential detonation. Optimizing drill hole placement will ensure that all material is successfully detonated, and additional explosives are not needed in order to achieve complete fragmentation.

- Optimize usage of explosive. Proper usage of explosive prevents the detonation of unnecessary, excess explosive and resulting excess emissions.

- Mine planning will result in blasting that is conducted in a manner that prevents overshooting and minimizes the area to be blasted.

Because the imposition of an emission standard is infeasible for blasting, Tintina proposes that BACT for reducing blasting emissions is a work practice condition to use proper blasting techniques, proper explosive selection, optimized application of explosives, and the utilization of best operating practices. These work practice conditions collectively reduce the amount of gaseous and particulate emissions resulting from explosives detonation.

BACT for Fugitive Particulate Emissions from Roads

Particulate emissions from fugitive road dust will result from vehicle and equipment travel on roadways within the BBCP mine site. BBCP roadway categories include permanent haul roads, temporary haul roads (used primarily during development phase), and mine access roads. Emissions were calculated for those roads based on vehicle type, activity, and frequency of trips. However, the overall control strategy for the roads will be discussed as a whole. The table below lists particulate control technologies available for reducing roadway fugitive emissions.

Technology	Description
No Add-on Control	This is the base case for proposed roadways.
Vehicle Restrictions	Restrict vehicle speed to reduce fugitive dust and increase distance between vehicles.
Surface Improvement	Improve roadway surfaces by paving with asphaltic concrete or other additives.
Surface Treatment	Wet suppression or surface treatment with chemical dust suppressants.

Initially, surface improvement using asphaltic concrete appears to be the most desirable road surface material and potential control technology. It offers a high coefficient of road adhesion and creates a surface that reduces dust problems. However, using this road composition has a seasonal disadvantage in climates with snow or freezing rain. The smooth surface of asphalt offers little resistance to the development of ice or snow causing the roadway to become extremely slick and remain so until a facility employs corrective measures. This could constitute a serious threat to operational safety in mining areas where rapid and frequent freeze conditions prevail. South-central Montana experiences many freeze/thaw periods throughout the year creating a potential safety hazard from the use of paved mine haul roadways.

The Design of Surface Haulage Roads Manual further states that "the high cost of asphaltic road surface severely restricts its feasibility on roads of short life. In most cases, a 4-inch layer of road surface may be accepted as the minimum requirement road depth due to the extreme weight of vehicles constantly traveling haul road surfaces. The cost of constructing a 4-inch thick layer ranges from $46 to $57 per square yard for labor, equipment, and material. Using the higher figure for a 5-mile road 30 feet wide would necessitate an expenditure of $440,000 for paving alone." Additionally, a sufficient sub- base and base coarse must be established prior to placing the asphalt. The necessary base course is an additional expense to be considered in total construction cost.

The Design of Surface Haulage Roads Manual continues to state that a great number of surface mining operations throughout the country are currently using gravel and crushed stone surface haulage roads. They provide a stable roadway that resists deformation and provides a relatively high coefficient of road adhesion with low rolling resistance. The Manual states that it would be impractical to use a permanent surface improvement control such as asphaltic concrete in areas where haul roads are subject to relocation or must accommodate heavy tracked vehicles.

A significant amount of traffic on BBCP roads will consist of haul trucks and other heavy machinery. Consequently, BBCP determined that surface improvement control techniques utilizing asphaltic concrete are both economically impractical and potentially hazardous.

The BBCP roads vary in both silt and moisture content and produce a varying degree of fugitive road dust emissions. A combination of surface treatments and vehicle restrictions are proposed to reduce fugitive road dust emissions
Tintina proposes the utilization of water as a surface treatment for all mine roads and along mine roads, with chemical dust suppressants considered as necessary (particularly on high traffic areas near private ranch buildings). Water sprays will be utilized to increase the moisture content of mine access roadway material in order to conglomerate particles and reduce the likelihood of fugitive particulate. The water sprays will be applied as necessary. Further vehicle restrictions will also be enforced as necessary in order to control fugitive emissions from mine access road travel. This includes the limitation of vehicle speed. These measures, as well as available reasonable precautions, will maintain compliance with ARM.17.8.304 and ARM 17.8.308.

BACT for Fugitive Particulate Emissions from Material Handling, Removal, and Stockpiles/Storage

Contemporaneous reclamation of disturbances will be a priority during the construction period. Maintaining reclaimed areas will be an ongoing BBCP focus. Surface disturbances related to cut and fill slopes associated with roads, ditches, embankment faces, and the disturbed perimeter of facility footprints will be reclaimed immediately where possible after final grades have been established. Reclamation includes: grading, slope stabilization, drainage control, topsoil and subsoil placement, and seeding. It is expected that these reclaimed areas will be fully revegetated within two to four years following construction. Temporary waste rock and life-of-mine copper-enriched rock storage areas will also be watered as necessary to minimize dust while loading or unloading material. Monitoring by site personnel during each shift will ensure watering is done to the level required to minimize the effects of dust at the site.

Construction-related disturbances that may generate dust and are not needed operationally will be recontoured, soil placed, and revegetated as quickly as possible following construction. This will include road cut-and-fill slopes, facility berms (Waste Rock storage and mill facility), embankments and berms of the Cemented Tailings Facility, Contact Water Pond, Process Water Pond, WRS and NCWR, buried pipelines, water diversion ditches, and soil/subsoil stockpiles. Dust control from the CTF is not expected to be problematic because the material will be moist (20%) and will be stabilized with cement additions to provide a non-flowable mass.

Other components of the dust control plan include (other specific emitting units are covered previously):

- Minimizing exposed soil areas to the extent possible by prompt revegetation of reclaimed areas,
- Establishing temporary vegetation on inactive soil and sub-soil stockpiles that will be in place for one year or more,
- Minimizing drop heights, etc. to minimize dust production from material transfer;
- Use of water and chemical dust suppression products to stabilize access and trucking road surfaces (with additional water application during dry periods), and
- Covering/enclosure of conveyor belts.

These measures, as well as available reasonable precautions, will maintain compliance with ARM.17.8.304 and ARM 17.8.308.

The control options selected have controls and control costs comparable to other recently permitted similar sources and are capable of achieving the appropriate emission standards.

IV. Emission Inventory

This project was modeled by finding the highest emissions for any activity during the proposed mine life, and assuming those activities all occur at the same time and in the same year. This provided a worst-case analysis to demonstrate there will be no violations of either NAAQS or MAAQS. The emitting units below include not only individual emitting units but also activities which generate emissions and were modeled. For example, underground blasting emissions are assigned as an emitting unit ID as are each of the various road sections for particulate matter emissions.

EMITTING UNIT ID	NAME
P1	250 TPH Portable Conical Crusher
P2	325-hp Portable Diesel Eng/Gen
P3	2 – Portable Screens (400 TPH each)
P4	131-hp Portable Diesel Eng/Gen
P5	545-kW/914-hp Portable Diesel Eng/Gen
P6	320-kW/536-hp Portable Diesel Eng/Gen
P7A & P7B	2- 1000-kW/1675-hp Diesel Eng/Gen - Emergency backup
P8	100-hp Diesel Eng/Gen – Emergency evac hoists
P9	50-hp Diesel Fire Pump – Emergency
P10A	23 MMBtu/hr Propane-fired Heater – Intake Vent for Upper Copper Zone
P10B	52 MMBtu/hr Propane-fired Heater – Intake Vent for Lower Copper Zone
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)
P12	3640 TPD Jaw Crusher
P13A	Mill Building (mill, lime storage, etc.)
P13B	Mill Building (lime area/slurry mix tank)
P14	Surge Bin Discharge

EMITTING UNIT ID	NAME
P15	Water Treatment Plant Lime Area
P16A	Backfill Plant Cement/Fly Ash Hopper
P16B	Backfill Plant Cement/Fly Ash Silo
P17	4- Portable Diesel Eng/Gen (400-hp total)
P18	Air Compressor - 275-hp Diesel Engine
UG	ANFO
F1	Road Dust, Mine Operating Year (MOY) 0 to 1
F2	Road Dust, MOY 1 to 2
F3	Road Dust, MOY 2 to 15, Annual Average
F4	Road Dust, MOY 16 and 17, Annual Average
F5	Road Dust, MOY 18
F6	Material Transfer to Temporary Stockpile, MOY 0 to 1.5
F7	Temporary Construction Stockpile
F8	Embankment Construction, MOY 0 to 1.5
F9	Backfill, NCWR Embankment Material to CTF, MOY 16 to 18
F10	Material Transfer to South Stockpile, MOY 0 to 1
F11	Excess Reclamation Stockpile (South)
F12	Material Transfer from South Stockpile, MOY 16 to 17
F13	Material Transfer to North Stockpile, MOY 0 to 1
F14	Excess Reclamation Stockpile (North)
F15	Material Transfer from North Stockpile, MOY 16 to 18
F16	Soil Removal and Stockpiling, MOY 0 to 1
F17	Topsoil Pile
F18	Subsoil Pile
F19	Soil Return, MOY 16 to 18
F20	Copper-enriched Rock Drop to Stockpile, MOY 2 to 3
F21	Copper-enriched Rock Stockpile (Mill Feed)
F22	Waste Rock Drop at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8
F23	Temporary WRS
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3
F25	Waste Rock Storage Pad Reclamation, MOY 3
F26	11 - 14-hp Portable Diesel-powered Light Plants (only 4 units will be used in Production Phase)
F27	500-gal Gasoline Storage Tank
F28	9 -Temporary Portable Propane-fired Heaters (37.8 MMBtu/hr total) (only 3 will be used in Production Phase)
F29	Road Dust, Construction Access Road, Year 0-2 Avg.
F30	Road Dust, Main Access Road, Year 2-15 Avg.
IEU1	Diesel Storage Tanks (250-gal, 500-gal, 10,000- gal)

The point source and fugitive emission inventory totals prepared for the modeling demonstration in the ambient air quality analysis against the MAAQS and NAAQS is summarized in the below table.

Source Cat.	Model Type	Modeled Emissions (Tons/Year)				
		PM_{10}	$PM_{2.5}$	CO	NO_2	SO_2
EVL	Point	1.020	1.000	28.090	19.460	0.630
EVU	Point	2.830	2.800	78.389	54.299	1.770
HEATER	Point	1.260	1.260	13.590	23.580	0.099
LIGHT	Point	1.480	1.480	4.510	20.900	0.008
P10A	Point	0.449	0.449	4.824	8.365	0.035
P10B	Point	1.021	1.021	10.908	18.912	0.079
P11	Point	0.050	0.050	0.190	0.750	0.080
P12	Point	3.190	3.190	n/a	n/a	n/a
P13A	Point	0.190	0.190	n/a	n/a	n/a
P13B	Point	1.240	1.240	n/a	n/a	n/a
P14	Point	1.880	1.880	n/a	n/a	n/a
P15	Point	1.240	1.240	n/a	n/a	n/a
P16A	Point	0.230	0.230	n/a	n/a	n/a
P16B	Point	0.450	0.450	n/a	n/a	n/a
P17	Point	1.150	1.150	14.400	13.540	0.210
P18	Point	0.400	0.400	6.930	7.920	0.150
P2	Point	0.470	0.470	8.190	9.360	0.170
P4	Point	0.280	0.280	4.720	3.770	0.070
P5	Point	1.320	1.320	23.020	42.101	0.490
P6	Point	0.770	0.770	13.520	15.450	0.030
PORTAL	Point	0.950	0.940	26.300	18.220	0.590
FUGITIVE	Volume	0.004	0.002	n/a	n/a	n/a
P1	Volume	0.591	0.109	n/a	n/a	n/a
P3A	Volume	1.296	0.088	n/a	n/a	n/a
P3B	Volume	1.296	0.088	n/a	n/a	n/a
ROAD	Volume	84.519	8.471	n/a	n/a	n/a
STOCKPILES	Volume	3.180	0.832	n/a	n/a	n/a
TRANSFERS	Volume	7.000	3.040	n/a	n/a	n/a
Total		**119.757**	**34.439**	**237.581**	**256.627**	**4.411**

Abbreviations:

EVL = Mine Ventilation Exhaust Lower Copper Zone
EVU = Mine Ventilation Exhaust Upper Copper Zone
Heater = Sum of Temporary Propane Heaters
Light = Sum of Diesel-fired Light Plants
Portal = Main Portal Exhaust
Road = Volume Sources for Roads
Stockpiles = Particulate Emissions from various stockpiles of material
Transfers = Particulate Emissions from material handling

PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less
CO = carbon monoxide
NO_2 = oxides of nitrogen

SO_2 = sulfur dioxide

The emission inventory reflects maximum allowable emissions for all pollutants based on maximum production and year-round operation for most operations (8,760 hours) with the following exceptions. Emergency generators are limited to 500 hours of operation per year and P10A and P10B are used on a seasonal basis for heating the interior of the mine. Road fugitive totals were averaged across the emissions during each year in the production phase.

VOC and PM emissions were also totaled for sources and do not have ambient air quality standards to compare to, but are shown here for completeness.

Potential Emissions Summary - PM and VOC

Point #	Emitting Unit	PM tons per year	VOC tons per year
	POINT SOURCES		
P1	250 TPH Portable Conical Crusher	1.31	--
P2	325-hp Portable Diesel Engine/generator	0.47	3.52
P3	2 Portable Screens (400 TPH each)	7.71	--
P4	131-hp Portable Diesel Engine/generator	0.28	1.42
P5	545-kW /914-hp Diesel Engine/generator	1.32	9.88
P6	320-kW /536-hp Diesel Engine/generator	0.77	5.80
P7	1000-kW /1675-hp Diesel Engine/generators (2) - Emergency	0.28	2.07
P8	100-hp Diesel Engine/generator - Emergency evac hoists	0.02	0.06
P9	50-hp Diesel Fire Pump - Emergency	0.01	0.03
P10A	23 MMBtu/hr Propane-fired heater @ Intake Vent for Upper Copper Zone	0.45	0.64
P10B	52 MMBtu/hr Propane-fired heater @ Intake Vent for Lower Copper Zone	1.01	1.45
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)	0.05	0.02
P12	Jaw Crusher (3640 TPD), Building/Dust Collector	3.19	--
P13A	Mill Building (mill, lime storage, etc.) Dust Collector	0.19	--
P13B	Mill Building (lime area/slurry mix tank) Dust Collector	1.24	--
P14	Surge Bin Discharge Dust Collector	1.88	--
P15	Water Trtmt Plant Lime Area Dust Collector	1.24	--
P16A	Backfill Plant Cement/Fly Ash Hopper Dust Filter/Collector	0.23	--
P16B	Backfill Plant Cement/Fly Ash Silo Dust Filter/Collector	0.45	--
P17	Portable diesel engine/generators (total of 400 hp, 4 units)	1.15	4.33
P18	Air Compressor - Diesel Engine (275 hp)	0.40	2.98
F26	Diesel-powered Light plants - 11 - 14 hp each	1.48	1.67
F27	Gasoline storage tank (double-walled 500 gal)		0.07
F28	Temporary portable propane heaters (37.8 MMBtu/hr total) - 9	1.27	1.81
UG	ANFO	0.11	--
	TOTAL POINT SOURCES	**26.49**	**35.74**
UG - EVU	Mine Ventilation Exhaust Upper Copper Zone - EVU		17.36
UG - EVL	Mine Ventilation Exhaust Lower Copper Zone - EVL		6.22
UG - P	Mine Ventilation Exhaust - Mine Portal		5.82
	ANFO (included in UG sources)		

Fugitive ID and Year of Emissions		PM Tons Per Year
F1	Road Dust, Mine Operating Year 0 to 1	152.7
F2	Road Dust, Mine Operating Year 1 to 2	56.42
F3	Road Dust, Mine Operating Year 2 to 15, annual average	17.79
F4	Road Dust, Mine Operating Years 16 and 17, annual average	73.8
F5	Road Dust, Mine Operating Year 18	11.68
F6	Material transfer to Temporary Stockpile, MOY 0 to 1.5	3.13
F7	Temporary construction stockpile	0.36
F8	Embankment Construction, Mine Operating Year 0 to 1.5	3.13
F9	Backfill, NWCR Embankment Material to CTF, MOY 16 to 18	1.78
F10	Material transfer to South Stockpile, MOY 0 to 1	1.49
F11	Excess reclamation stockpile (South)	0.08
F12	Material transfer from South Stockpile, MOY 16 to 17	1.49
F13	Material transfer to North Stockpile, MOY 0 to 1	2.13
F14	Excess reclamation stockpile (North)	0.17
F15	Material transfer from North Stockpile, MOY 16 to 18	0.82
F16	Soil Removal and Stockpiling, Mine Operating Year 0 to 1	4.99
F17	Topsoil pile	0.08
F18	Subsoil pile	0.44
F19	Soil Return, Mine Operating Year 16 to 18	4.17
F20	Copper-enriched rock drop to stockpile, MOY 2 to 3	0.16
F21	Copper-enriched rock stockpile (mill feed)	0
F22	Waste Rock Drop -at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8	0.87
F23	Temporary waste rock storage (WRS)	0.019
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3	1.39
F25	Waste Rock Storage Pad Reclamation, MOY 3	1.65
F29	Road Dust, Construction Access Road, Year 0 - 2 Avg.	0.9
F30	Road Dust, Main Access Road, Year 2 - 15 Avg.	102.19
	Emissions are shown by Mine Operating Year (MOY)	

V. Existing Air Quality

This permit is for an underground copper mine and surface mill buildings in Meagher County, Montana. Meagher County has been designated unclassified/attainment with all ambient air quality standards.

VI. Ambient Air Impact Analysis

The project is scheduled to occur in three phases; development, production and reclamation. For demonstration with NAAQS and MAAQS, highest emitting activities have been assumed to occur at the same time regardless of which phase they actually occur in. This assumption shows that even with a conservative approach, the emitting units and sources of criteria pollutants will not violate ambient air quality standards. The project would be classified as a minor source for PSD-NSR and a major source under Title V regulations. Temporary engines utilized in the development phase of the mine, trigger the Title V major status. Tintina could later decide to revisit the Title V major status following the development phase but as currently presented, Tintina would need to apply for a Title V Operating permit within 12-months after commencing operation of the engines and temporary equipment presented for operation during the development phase.

Tintina conducted a screening analysis on CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$ for various long and short-term averaging periods. All emissions were held constant across all averaging periods. Tintina modeled 26 discrete point sources, and 1583 volume sources. The Heater and Light points represent multiple units distributed across the site and the four emergency generators are not included in the 26 point source total. The majority of volume sources were equally spaced road segments, modeled for fugitive dust emissions of PM_{10} and $PM_{2.5}$.

The table below reports the total emissions modeled for each pollutant.

Source Cat.	Model Type	Modeled Emissions (Tons/Year)				
		PM_{10}	**$PM_{2.5}$**	**CO**	**NO_2**	**SO_2**
EVL	Point	1.020	1.000	28.090	19.460	0.630
EVU	Point	2.830	2.800	78.389	54.299	1.770
HEATER	Point	1.260	1.260	13.590	23.580	0.099
LIGHT	Point	1.480	1.480	4.510	20.900	0.008
P10A	Point	0.449	0.449	4.824	8.365	0.035
P10B	Point	1.021	1.021	10.908	18.912	0.079
P11	Point	0.050	0.050	0.190	0.750	0.080
P12	Point	3.190	3.190	n/a	n/a	n/a
P13A	Point	0.190	0.190	n/a	n/a	n/a
P13B	Point	1.240	1.240	n/a	n/a	n/a
P14	Point	1.880	1.880	n/a	n/a	n/a
P15	Point	1.240	1.240	n/a	n/a	n/a
P16A	Point	0.230	0.230	n/a	n/a	n/a
P16B	Point	0.450	0.450	n/a	n/a	n/a
P17	Point	1.150	1.150	14.400	13.540	0.210
P18	Point	0.400	0.400	6.930	7.920	0.150
P2	Point	0.470	0.470	8.190	9.360	0.170
P4	Point	0.280	0.280	4.720	3.770	0.070
P5	Point	1.320	1.320	23.020	42.101	0.490
P6	Point	0.770	0.770	13.520	15.450	0.030
PORTAL	Point	0.950	0.940	26.300	18.220	0.590
FUGITIVE	Volume	0.004	0.002	n/a	n/a	n/a
P1	Volume	0.591	0.109	n/a	n/a	n/a
P3A	Volume	1.296	0.088	n/a	n/a	n/a
P3B	Volume	1.296	0.088	n/a	n/a	n/a
ROAD	Volume	84.519	8.471	n/a	n/a	n/a
STOCKPILES	Volume	3.180	0.832	n/a	n/a	n/a
TRANSFERS	Volume	7.000	3.040	n/a	n/a	n/a
Total		**119.757**	**34.439**	**237.581**	**256.627**	**4.411**

The application also included the use of four emergency generators for 728 hours per year (permit contains a limit for 500 but modeling was done at 728) for each. These emissions were modeled separately on the assumption that normal operations would cease if the emergency generators were activated. The table below shows the emissions for the emergency generators.

Source	Emissions (Tons/Year)				
	$PM_{2.5}$	**PM_{10}**	**NO_2**	**CO**	**SO_2**
P7A	2.409	2.409	77.176	42.216	0.889
P7B	2.409	2.409	77.176	42.216	0.889
P8	0.289	0.289	3.373	3.592	0.053
P9	0.144	0.145	1.691	1.800	0.027
Total	5.251	5.252	159.416	89.823	1.857

The SIL and MAAQS/NAAQS compliance demonstrations were conducted using the latest available version of AERMOD and associated preprocessors. Specifically:

- AERMOD version 16216r: Air dispersion model
- AERMET version 16216: processes on-site and NWS meteorological data for input to AERMOD
- AERSURFACE version 13016: processes 1992 National Land Cover Data surface characteristics for input to AERMET
- AERMAP version 11103: Processes National Elevation Data from the USGS to determine elevation of sources and receptors for input into AERMOD
- BPIPPRM version 04274: characterizes building downwash for input to AERMOD
- BEEST version 11.10: GUI used for easier processing of AERMOD inputs and outputs.

Regulatory default options were used for all model runs. Rural dispersion coefficients were applied because less than 50% of the site location is classified into a developed land use category. All of Montana currently meets this criterion. Metrological data was obtained from an on-site meteorological tower at the proposed facility location. Data was collected from May 2012, through April 2017, and used in the modeling analysis. National Weather Service data from the Helena Regional Airport (WBAN 24144) was used to supplement missing on-site data for the five-year period. The Great Falls Upper Air station (WBAN 04102) was used for upper air data.

Source parameters were provided by Tintina and remained constant across all pollutants and averaging times. The tables below outline the source parameters used for point and volume sources for the facility, followed by parameters for the emergency generators.

Point source parameters for the facility operations are listed below.

Source Cat.	Source	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
EVL	EVL	0.91	294.25	7.28	4.88
EVU	EVU	0.91	294.25	20.32	4.88
Heater	PROA	1.83	755.35	8.79	0.1

Source Cat.	Source	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
	PROB	1.83	755.35	8.79	0.1
	PROC	1.83	755.35	8.79	0.1
Light	LIGHTA	0.91	866.45	9	0.08
	LIGHTB	0.91	866.45	9	0.08
	LIGHTC	0.91	866.45	9	0.08
	LIGHTD	0.91	866.45	9	0.08
P10A	P10A	0.91	294.25	20.32	4.88
P10B	P10B	0.91	294.25	7.28	4.88
P11	P11	1.22	810.95	18.1	0.1
P12	P12	10	ambient temp	17.78	0.61
P13A	P13A	25	ambient temp	13.71	0.15
P13B	P13B	25	ambient temp	20.14	0.36
P14	P14	15	ambient temp	18.7	0.46
P15	P15	10	ambient temp	20.14	0.36
P16A	P16A	15	ambient temp	19.74	0.15
P16B	P16B	15	ambient temp	17.54	0.23
P17	P17	1.22	838.75	36.96	0.1
P18	P18	1.68	737.15	43.54	0.15
P2	P2	1.68	737.15	50.11	0.15
P4	P4	1.83	755.37	32.83	0.1
P5	P5	2.13	791.35	52.63	0.23
P6	P6	2.44	743.15	25.46	0.23
PORTAL	PORTAL	0.3	294.25	6.04	5.18

Volume source parameters for the facility operations are listed below.

Source Cat.	Source	Release Height (m)	Init Sy (m)	Init Sz (m)
Fugitive	DRAIN_CTF	2	10.47	1.86
	DRAIN_PWP	2	7.44	1.86
	POWDER	2	10.23	1.86
P1	P1	2.16	3.09	2.01
P3A	P3A	2.45	2.77	2.28
P3B	P3B	2.45	2.77	2.28
Road	ACC	2.11	6.48	1.96
	CON	2.11	3.88	1.96
	CTF Road	3.5	7.44	3.25
	Service Road	3.5	4.51	3.25
Stockpiles	CUPILE	9	16.28	8.37
	NPILE	4.5	33.72	4.19
	SPILE	4.5	27.91	4.19
	SUBS	4.5	32.09	4.19
	TEMP	3.05	18.14	2.84
	TOPS	4.5	27.91	4.19
	WRS	7.5	53.49	6.98
Transfers	CTF_T	2	36.05	1.86
	CUPILE_T	2	16.28	1.86
	CWP_T	2	17.83	1.86
	MILL_T	2	20.93	1.86
	NCWR_T	2	29.07	1.86
	PORTAL_T	2	13.37	1.86
	PWP_T	2	22.67	1.86
	WRS_T	2	17.83	1.86

The emergency generators' source parameters are listed below.

Source	Source Parameters				
	Base Elev. (m)	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
P7A	1785	6.1	746.55	49.05	0.3
P7B	1785	6.1	746.55	49.05	0.3
P8	1768.9	1.22	838.75	36.96	0.1
P9	1785	1.22	810.95	18.1	0.1

Tintina conducted a screening analysis in concurrence with the NAAQS/MAAQS analysis to determine whether the proposed project would result in predicted concentrations exceeding any of the significant impacts levels (SILs) for any of the criteria pollutants for the various averaging periods. The results of the screening analysis from the Tintina MAQP application are shown below.

Pollutant	Avg. Period	Modeled Conc. (µg/m3)	Class II SIL (µg/m3)	Significant (Y/N)
PM_{10}	24-hr	108.6	5	Y
$PM_{2.5}$	24-hr	16.6	1.2	Y
	Annual	4.2	0.3	Y
NO_2	1-hr	263	7.52	Y
	Annual	11.7	1	Y
SO_2	1-hr	13.8	7.8	Y
	3-hr	20.5	25	N
	24-hr	3.6	5	N
	Annual	0.19	1	N
CO	1-hr	2725	2,000	Y
	8-hr	459.2	500	N

SILs were exceeded for 24-hr PM_{10}, 24-hr and annual $PM_{2.5}$, 1-hr and annual NO_2, 1-hr SO_2 and 1-hr CO. Thresholds above the SILs requires that a compliance demonstration using existing nearby industrial sources in addition to background concentrations be conducted with the resulting concentrations compared to NAAQS and MAAQS. As the proposed project site is not in close proximity with other existing industrial facilities, no nearby sources were included in the NAAQS and MAAQS compliance demonstration. Therefore, the compliance demonstration was simplified to adding the modeled concentrations from the proposed project to approved background concentrations.

Tintina also conducted a screening analysis for emergency operations in concurrence with the NAAQS/MAAQS analysis to determine whether the emergency operations would result in predicted concentrations exceeding any of the significant impacts levels (SILs) for any of the criteria pollutants for the various averaging periods. The results of the screening analysis from the Tintina MAQP application are shown below.

Pollutant	Avg. Period	Modeled Conc.[(a)] ($\mu g/m^3$)	Class II SIL ($\mu g/m^3$)	Significant (Y/N)
PM_{10}	24-hr	1.4	5	N
$PM_{2.5}$	24-hr	0.97	1.2	N
	Annual	0.03	0.3	N
NO_2	1-hr	240	7.52[(b)]	Y
	Annual	0.79	1	N
	1-hr	5.6	7.8[(c)]	N

Pollutant	Avg. Period	Modeled Conc.[(a)] (μg/m^3)	Class II SIL (μg/m^3)	Significant (Y/N)
SO_2	3-hr	3.8	25	N
	24-hr	0.48	5	N
	Annual	0.013	1	N
CO	1-hr	398	2,000	N
	8-hr	70	500	N

Background concentrations prepared by Tintina were collected at the Sieben Flats NCore monitoring station (Lewis and Clark County) and the Lewistown monitoring station (Fergus County). The Sieben Flats station monitors background air quality data is part of the National Core (NCore) multi-pollutant monitoring network which addresses monitoring objectives including long-term health assessments contributing to ongoing reviews of the NAAQS and the support of scientific research in public health, atmospheric science, and ecological science. The monitoring station resides approximately 17.7 miles north-northeast of Helena, Montana, in an area of rural, agricultural land with characteristics similar to the region surrounding the BBCP. Monitoring data from the Sieben station was used for all pollutants collected at the station, which included all criteria pollutants except for NO_2 and PM_{10}. The Lewistown station provides another set of monitoring data characteristic to the BBCP location and was used for NO_2 and PM_{10} background concentration values.

Pollutant	Averaging Period	Background[(a)] Concentration (μg/m^3)	Monitoring Station
PM_{10}[(b)]	24-hour	30.3[(c)]	Lewistown
$PM_{2.5}$[(b)]	24-hour	10	Sieben Flatts NCORE
	Annual	2.5	Sieben Flatts NCORE
SO_2	1-hour	5.24[(d)]	Sieben Flatts NCORE
CO[(b)]	1-hour	1031[(c)]	Sieben Flatts NCORE
NO_2	1-hour	20.7[(e)]	Lewistown
	Annual	1[(f)]	Lewistown

(a) NAAQS design values provided in 2017 Network Plan produced by Montana DEQ unless noted otherwise.
(b) Values exclude EPA or DEQ defined exceptional events.
(c) NAAQS design values derived from EPA Monitoring Values Report data.
(d) Concentration represents 2 ppb.
(e) Concentration represents 11 ppb.
(f) Concentration represents 0.5 ppb. Value not a regulatory calculated. Internally calculated arithmetic mean provided in 2017 Network Plan. Used in lieu of no NO_2 Annual NAAQS Design Value

The compliance demonstration for the modeled inputs against the NAAQS and MAAQS is shown below.

Pollu-tant	Avg. Period	Modeled Conc. (μg/m^3)	Background Conc. (μg/m^3)	Ambient Conc. (μg/m^3)	NAAQS (μg/m^3)	% of NAAQS	MAAQS (μg/m^3)	% of MAAQS
PM_{10}	24-hr	89.7[a]	30.3	120	150	80%	150	80%
$PM_{2.5}$	24-hr	12.0[b]	10	22.0	35	63%	------	------
	Annual	4.25[c]	2.5	6.75	12	56%	------	------
NO_2	1-hr	131[d]	20.7	151.7	188	81%	564	36%[g]
	Annual	11.7[c]	1	12.7	100	13%	94	13%
SO_2	1-hr	5.8[e]	5.24	11.03	196	6%	1309	1%
CO	1-hr	1890[f]	1031	2921	40,000	7%	26,450	11%

(a) Modeled concentration is the high-6th-high modeled over a 5-year concatenated met period.
(b) Modeled concentration is the high-8th-high modeled over a 5-year concatenated met period.
(c) Modeled concentration is the highest annual average over the modeled five-year period.
(d) Modeled concentration is the high-8th-high modeled over a 5-year concatenated met period.
(e) Modeled concentration is the high-4th-high modeled over a 5-year concatenated met period.
(f) Modeled concentration is the high-2nd-high modeled over a 5-year concatenated met period.
(g) Modeled concentration is the high-2nd-high modeled impact over a 5-year concatenated met period. High-2nd-high concentration is 184 ug/m3 and was not included in the table. With the addition of the 20.7 ug/m3 background value the ambient impact is 36% of the MAAQS.

The compliance demonstration for the emergency operations for NO_2 1-hr are shown against the NAAQS and MAAQS below.

Pollu-tant	Avg. Period	Modeled Conc. (μg/m^3)	Background Conc. (μg/m^3)	Ambient Conc. (μg/m^3)	NAAQS (μg/m^3)	% of NAAQS	MAAQS (μg/m^3)	% of MAAQS
NO_2	1-hr	139.26[a]	20.7	159.96	188	85%	------	------

Modeled results of the full facility indicate the 1-hr NO_2 standard and 24-hr PM_{10} standard are at 81% and 80% of the NAAQS, respectively. Modeling results of the emergency operations indicate the 1-hr NO_2 standard is 85% of the NAAQS. These are the highest modeled concentrations with the next highest being the 24-hr $PM_{2.5}$ concentrations. Given the modeling approach of assuming the highest emitting activities occur at the same time, emission estimates are generally over-stated and since no pollutant is over either the NAAQS or MAAQS for any averaging period, the proposed project has demonstrated compliance with the NAAQS and MAAQS.

The Department determined, based on the modeling analysis, accompanying assumptions and conditions including BACT methods established in MAQP #5200-00 that the impacts from this permitting action will be minor. The Department believes it will not cause or contribute to a violation of any ambient air quality standard. The full modeling analysis submitted with the MAQP application, is on-file with the Department.

VII. Taking or Damaging Implication Analysis

As required by 2-10-105, MCA, the Department conducted the following private property taking and damaging assessment.

YES	NO	
X		1. Does the action pertain to land or water management or environmental regulation affecting private real property or water rights?
	X	2. Does the action result in either a permanent or indefinite physical occupation of private property?
	X	3. Does the action deny a fundamental attribute of ownership? (ex.: right to exclude others, disposal of property)
	X	4. Does the action deprive the owner of all economically viable uses of the property?
	X	5. Does the action require a property owner to dedicate a portion of property or to grant an easement? [If no, go to (6)].
		5a. Is there a reasonable, specific connection between the government requirement and legitimate state interests?
		5b. Is the government requirement roughly proportional to the impact of the proposed use of the property?
	X	6. Does the action have a severe impact on the value of the property? (consider economic impact, investment-backed expectations, character of government action)
	X	7. Does the action damage the property by causing some physical disturbance with respect to the property in excess of that sustained by the public generally?
	X	7a. Is the impact of government action direct, peculiar, and significant?
	X	7b. Has government action resulted in the property becoming practically inaccessible, waterlogged or flooded?
	X	7c. Has government action lowered property values by more than 30% and necessitated the physical taking of adjacent property or property across a public way from the property in question?
	X	Takings or damaging implications? (Taking or damaging implications exist if YES is checked in response to question 1 and also to any one or more of the following questions: 2, 3, 4, 6, 7a, 7b, 7c; or if NO is checked in response to questions 5a or 5b; the shaded areas)

Based on this analysis, the Department determined there are no taking or damaging implications associated with this permit action.

VIII. Environmental Assessment

An EA is not being conducted as part of this preliminary determination, as the proposed underground mine and mill is being evaluated by the Department of Environmental Quality and a separate Environmental Impact Statement (EIS) is in the process of being developed. All project-related documents including the EIS related documents are being posted on the DEQ website at: http://deq.mt.gov/Land/hardrock/tintinamines.

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