Draft Environmental Impact Statement

Appendices

Stillwater Mining Company's Revised Water Management Plans and Boe Ranch LAD

November 2010

Montana Department of Environmental Quality

Beartooth Ranger District
Custer National Forest

Yellowstone Ranger District
Gallatin National Forest

Appendix A — Synopses of Related Environmental Documents

This appendix includes synopses of related environmental documents for the Stillwater and East Boulder mines.

A.1 Stillwater Mine

A.1.1 Final Environmental Impact Statement, Stillwater Project

Final Environmental Impact Statement, Stillwater Project, Stillwater County, Montana. Prepared by Montana Department of State Lands and USDA Forest Service, Custer National Forest. December 1985.

A.1.1.1 Proposed Action

Stillwater Mining Company proposed to open a platinum-palladium mine within the Stillwater mineral complex. The project would have a 30-year mine life at a daily production rate of 1,000 tons of ore. Underground mining by means of cut-and-fill stoping primarily would be used. Tailings from the milling process would be separated into the sand fraction and the fines fraction. The sand fraction would be backfilled into mining stopes. The fine tailings would be placed in a tailings pond next to the mill. Concentrate from the mill would be trucked to Columbus and shipped by rail to various markets. The project permit area would cover 550 acres.

A.1.1.2 Alternatives Analyzed

In addition to the No Action alternative, several action alternatives were evaluated in detail in the analysis. Production System Alternatives consisted of three alternative tailings disposal locations (including the Hertzler Ranch Site). Mine Portal Arrangement Alternatives were chosen from three arrangements. Electrical Power Supply Alternatives were selected from three options. A public access route to the West Fork Stillwater River was chosen from two possibilities.

A.1.1.3 Environmental Impacts of the Proposed Action

The main areas where issues of concern were identified included: water quality and quantity, reclamation, wildlife, aesthetic values, transportation, surface subsidence, socioeconomic effects, and scenic quality. Water quantity and quality would be affected similarly to the effects from exploration. The mine would probably discharge about the same amount and quality of water as during exploration. Detectable increases in nitrate and total nitrogen concentrations in alluvial ground water would continue downstream of the mine. Water quality of the Stillwater River would be unaffected. Very high flood flows (greater than the 1000-year flood) would encroach on the tailings impoundment, contributing sediment to the Stillwater River. During such a flood, however, the sediment load would be so high from natural sources that the added mine-related sediment would be undetectable.

Reclamation would be affected by soil disturbance and storage. Soils would lose organic matter and this loss would yield a low post-mining water- and nutrient-holding capacity. The decreased capacity would probably result in lower vegetative densities during the initial reclamation years and perhaps some initial revegetation failures. A loss of, or reduction in, soil microorganism populations caused by prolonged storage could result in lower plant species diversity and vigor for several years following initial revegetation. Forage production would increase, primarily from revegetation of 59 acres of previously disturbed lands. Plant diversity would decline from pre-mining levels.

Critical wildlife habitat would not be disturbed. Mule deer and bighorn sheep would lose a small amount of wintering range. These two species could also react to mining activities and noise by withdrawing from nearby areas. The MTFWP believed a herd reduction was imminent and that herd elimination was possible if mining were permitted. Road kills of deer would increase. Population increases in Stillwater County, of which only a portion would be mine-related, would increase housing construction, hunting and other recreation, and poaching by an unknown amount. No threatened or endangered species would be adversely affected by the proposed project.

Aesthetic impacts would be visual (scenic quality) and auditory. The mine and mill would alter the landscape, significantly affecting the visual resources at the mine site. The visual quality objectives would not be met, if at all, until sometime after the completion of reclamation. Noise levels near the mine site would increase considerably. However, because noise decreases rapidly with distance, travelers on County Road 419 would be exposed to only a small increase in noise levels. Residents within 0.5 miles could hear noises associated with the facility.

Transportation effects would include increased traffic volumes on CR 419, CR 420, and CR 78 because of increases in mine-related and household trips. CR 419 and 420 would be most affected by work traffic, and CR 78 by household trips. Increased traffic would result in increased traffic accidents and road maintenance costs. Ranchers, recreationists, and wildlife could be adversely affected by the increased traffic.

Surface subsidence from possible collapse of portions of the mine workings would present minimal long-term risk to the public.

Socioeconomic effects: Area employment and income would both increase. The first year of project construction would add 100 to 150 new jobs to total county employment. If the company proceeded with project development, mill construction would add an additional 150 jobs. During operations the project would employ 200 to 220 people. About 89 jobs would be filled by local residents. The project could increase the population of Stillwater County by 8.1 percent, Absarokee by 24.7 percent, and Columbus by 10.3 percent above the 1995 level without the mine.

A.1.1.4 Decision

The Commissioner of the Department of State Lands and the Supervisor of the Custer National Forest identified a preferred alternative, approved the project, and issued a Record of Decision in 1985.

A.1.2 Preliminary Environmental Review/Environmental Assessment (PER/EA), Stillwater Project East Side Adit Development

Preliminary Environmental Review/Environmental Assessment (PER/EA), Stillwater Project East Side Adit Development. Montana Department of State Lands and Custer National Forest. February 1989.

A.1.2.1 Proposed Action

Stillwater Mining Company proposed to develop the ore reserves on the east side of the Stillwater River in order to reach 1000 tons per day (TPD) of ore production. SMC proposed the development of six adits and one shaft. Ore from the east side development would be trucked to the west side for processing in the existing mill/concentrator. Waste rock not used for construction or other uses would also be trucked to the west side for use in constructing the tailings impoundment dam. Tailings impoundment capacity and design would not change from that approved in 1986.

A.1.2.2 Alternatives Analyzed

Three alternatives were considered in detail. They included the Proposed Action (Alternative 1), the Proposed Action with several agency-identified mitigation measures (Alternative 2), and the No Action Alternative (Alternative 3).

A.1.2.3 Environmental Impacts of Proposed Action

Various impacts were considered capable of being fully mitigated with the implementation of the following measures: (1) two measures to provide traffic reduction; (2) two measures to reduce visual impact; (3) six specific actions to compensate for losses to bighorn sheep habitat; (4) two measures to protect raptors; (5) four measures to monitor ground water quantity and water rights; (6) three measures to protect water quality; and (7) a measure to protect cultural resources.

A.1.2.4 Decision

The decision was made by the Commissioner of the Department of State Lands and the Supervisor of the Custer National Forest to select Alternative 2 and approve the project (Amendment No. 5) with a Finding of No Significant Impacts on March 2, 1989.

A.1.3 Final Environmental Impact Statement, Stillwater Mine Expansion 2000 Tons Per Day, Application to Amend Plan of Operations and Permit No. 00118.

Final Environmental Impact Statement, Stillwater Mine Expansion 2000 Tons Per Day, Application to Amend Plan of Operations and Permit No. 00118. Prepared by Montana Department of State Lands, Montana Department of Health and Environmental Services, and Forest Service. 1992.

A.1.3.1 Proposed Action

SMC proposed to increase the mine production rate up to 730,000 tons per year (2,000 TPD). Included in the proposal was enlargement of the tailings impoundment, expanding waste rock storage, new buildings and berms, etc, on 35 acres, expanding processing facilities capabilities, relocating certain buildings, an incremental addition of 161 additional employees, and an application to change ambient water quality for total dissolved solids, ammonia, nitrates, and metals in both surface and ground water.

A.1.3.2 Alternatives Analyzed

Five alternatives were considered in detail. They were No Action, Proposed Action, Proposed Action with Modified Tailings Impoundment (Partial Approval), Proposed Action with Advanced Water Treatment, and Proposed Action with Modifications to Tailings Impoundment, Waste Rock Storage, and Water Resources.

A.1.3.3 Environmental Impacts of Proposed Action

About 35 acres of new disturbance would occur. Marginal reclamation would occur because of limited replacement soils. Facilities would eliminate vegetative production on 42 acres. Irrigation with nitrate-rich water would increase plant growth. The bighorn sheep herd would continue to be threatened; facilities would eliminate forage on the toe dike. Atmospheric emissions would increase, but permit levels would not be exceeded. Recreational use in area would increase some. Visually, the embankment would be raised 14 feet, the rock armor would be visually uniform, a longer period of time would be necessary to achieve retention of visual quality, and visual screening would be provided by berm on east side. A total employment impact of 232 jobs would occur. Stillwater County's population would increase by 150 people more than projected. Demands would increase for housing, community services, and community facilities. Traffic would double to about 262 vehicles per day.

A.1.3.4 Decision

The agency decision makers approved and permitted the amendment (Amendment No. 8) on September 23, 1992.

A.1.4 Final Environmental Impact Statement, Stillwater Mining Company Underground Valley Crossing and Mine Plan.

Final Environmental Impact Statement, Stillwater Mining Company Underground Valley Crossing and Mine Plan. Application to Amend the Plan of Operations, Permit No. 00118. Prepared by Montana Department of Environmental Quality. February 1996.

A.1.4.1 Proposed Action

In April, 1995, SMC proposed to amend its Operating Permit by proposing to connect the East and West mining areas by means of a haulage drift located at the 4400-foot level of the mine. The haulage drift would be developed beneath the Stillwater River and its floodplain. As part of the proposed amendment, SMC sought approval to mine the ore body at and below the 4400-foot level if and when mineralization was defined.

The project would be conducted in two phases. Phase 1 would include completion of the 4400-foot level haulage drift and the diamond drilling necessary to define the mineralization. Phase 2 would involve implementation of mining below the surface crown pillar. Approval of the proposed amendment would allow SMC to reduce ore and waste handling costs by reducing haul distances to the mill and to crush ore prior to reaching the mill, to access and further delineate additional ore reserves, and to reduce conflict with recreational traffic using County Road 419.

A.1.4.2 Alternatives Analyzed

Three alternatives were considered by DEQ. They were the Proposed Action, No Action alternative, and Proposed Plan with Modifications.

A.1.4.3 Environmental Impacts of Proposed Action

Impacts were analyzed to address the issues of geotechnical stability, increased inflow of ground water to the workings, and water quality of both surface and ground water. Stability analyses indicated the proposed crown pillar thickness (200 ft) was adequate. The long-term stability of the pillar was not considered to be an issue, particularly because SMC proposed to backfill the 4400-ft level haulage way at closure where it would be adjacent to the base of the crown pillar. In addition, all stopes would be backfilled upon completion of mining.

Inflows of ground water were expected to be similar to flows previously observed in the East Side Mine. The predicted rate of inflow to the haulage level

(200 gpm) was not expected to have any impact on flow in the Stillwater River or ground water levels in the valley.

Ground water and surface water quality were not expected to change following implementation of the proposed action. Mine production rates and associated nutrient loading from the mining activities would not be increased by the proposed action and would not exceed the levels analyzed in the SMC 2000 TPD EIS.

A.1.4.4 Decision

The Director of DEQ approved the permit amendment (Amendment No. 9) and the project was permitted in 1996.

A.1.5 Final Environmental Impact Statement Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment.

Final Environmental Impact Statement Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment. Prepared by Montana Department of Environmental Quality and USDA Forest Service. October 1998

A.1.5.1 Proposed Action

The proposed action amended operating permit #00118. Specific changes included: a new tailings impoundment on the Hertzler Ranch 7.8 miles northeast of the mine; a system of pipelines along Stillwater County roads 419 and 420 connecting the tailings impoundment to the mine and mill; expanding the waste rock storage areas on the east side of the Stillwater River; relocating the Land Application Disposal (LAD) system from the east side of the Stillwater River to both the Stratton Ranch and the Hertzler Ranch; and removing the 2000 tons per day restriction on processing ore.

A.1.5.2 Alternatives Analyzed

Four alternatives were analyzed: Alternative A — No Action, Alternative B — Proposed Action, Alternative C — Modified Centerline Expansion of the Nye Impoundment and a smaller Hertzler impoundment, Alternative D — Modified Centerline Expansion of the Nye impoundment plus a new impoundment and waste rock storage facility on the east side of the Stillwater River.

A.1.5.3 Environmental Impacts of Proposed Action

Key issue areas included water quality and quantity, wildlife, fisheries, air quality, socioeconomics, tailings impoundment stability, aesthetics, transportation and reclamation. Ground water quality would be affected by localized increases in nitrates. Surface water quantities would experience short-term increases in runoff. Surface water quality would experience minor degradation but no standards would be violated. Nitrate levels in the Stillwater River would increase, but would not violate any standard. Approximately 1.5 acres of wetlands (Waters of the U.S.) would be affected by the pipeline route, but these effects would be mitigated through in-kind reclamation. Air quality would experience slight increases in particulate matter, especially during construction. Vegetation and wildlife habitat communities on 678 acres would be changed from the current agricultural mixture of species to a different mixture after reclamation. Fish reproduction in the Stillwater River could be affected from increases in sedimentation over the short-term.

Socioeconomic effects would include approximately 424 new residents, including 34 new school students, 45 new jobs created, and a continuation of tax payments by SMC for an additional 30 years. Visual intrusion by new facilities would not violate visual quality objectives on Forest lands. Construction noise would be created at all new facilities. Transportation effects would increase the AADT on Stillwater County roads 419 and 420 from 803 to 906. Construction of the pipeline corridors would disrupt traffic on the roads in the short-term. No direct effects would occur to cultural resources.

A.1.5.4 Decision

The Director of DEQ and Supervisor of the CNF approved the permit amendment and Operating Plan revision, respectively, and the Proposed Action with mitigation measures was permitted in 1998.

A.2 East Boulder Mine

A.2.1 Final Environmental Impact Statement, East Boulder Mine Project.

Final Environmental Impact Statement, East Boulder Mine Project. Prepared by Montana Department of State Lands, USDA Forest Service, and Montana Department of Health and Environmental Services. 1992.

A.2.1.1 Proposed Action

The East Boulder Mine Project consists of an underground mine, a surface mill and support complex, a tailings impoundment and ancillary facilities located in Sweet Grass County about 30 miles south of Big Timber, MT. The majority of surface facilities would be in the East Boulder River valley.

A.2.1.2 Alternatives Analyzed

Seven alternatives were analyzed including: 1 – No Action, 2 – Proposed Action, 3 – Modified tailing impoundment configuration, 4 – Alternative access road and power line, 5 – Alternative power supply corridor systems, 6 – Water treatment options, 7 – Proposed Action with modifications, and 8 – Twin production adits instead of one adit.

A.2.1.3 Environmental Impacts of Proposed Action

Issue areas were identified as socioeconomics, transportation, surface and ground water, air quality and noise, wildlife, fisheries and vegetation, recreation and visuals, land use, geology, reclamation, health and safety, and the permitting procedure. Population growth was expected to occur in Big Timber as a result of increased employment at the mine. About 170 persons in the first year and up to 600 workers maximum would be employed. Indirect employment was expected to increase, as is the student population. Demands for housing and community services were expected to increase. Estimated tax revenues resulting from the project increase, but would lag behind the increase in need for services. Transportation effects would include increases in traffic, road maintenance, and a reduction in traffic safety for residents. Potential impacts to surface waters include sediment runoff to streams and water quality degradation from turbidity and nutrients or chemical loading. Impacts to ground water quality could occur from improper disposal of process waters, impoundment leakage, and chemical spills. Air quality would be decreased due to increased particulate and gaseous emissions. Noise would be generated at all facilities. Vegetation and wildlife habitat would be disturbed on 233 acres (most of which is timbered), and disturbance to wildlife would increase from increased traffic and area access. Fisheries could be affected by sediment loading, changes in water quality, changes in fish passages, and in fishing pressure.

Impacts to fishing and hunting quality and dispersed recreation would result. Visual effects on line and color in foreground views would result from construction of facilities, especially the tailings impoundment. Effects on land use would result from increased noise and traffic, and to the timber management by the USFS. Geological impacts would include changing landforms, creating a tailings impoundment, and the depletion of the mineral resources.

A.2.1.4 Decision

The decision-makers of DEQ, DHES and the Supervisor of the GNF approved the mine operating permit application (Plan of Operations), and the Proposed Action with mitigation measures was permitted in 1992.

Appendix B — Monitoring Plan for Boe Ranch LAD System Agency-Mitigated Alternative 3C

If the Boe Ranch LAD System Agency-Mitigated Alternative 3C is selected and approved by the agencies, the additional components listed in this appendix would be included in the Stillwater Mining Company's (SMC's) monitoring plan. Although the monitoring program under the Boe Ranch LAD System Proposed Action Alternative 2C would indicate effects on ground water from land application disposal (LAD), it would not provide data to evaluate the health of the soil resource beneath the LAD area. Selection of the Agency-Mitigated Alternative 3C would minimize the potential for direct adverse short-term and long-term effects from the accumulation of nitrogen and salts in Boe Ranch soils. The agencies' additional monitoring requirements and action plans would ensure that nitrogen and salts problems do not develop over the life of the Boe Ranch LAD system.

Under the Agency-Mitigated Alternative 3C, SMC would monitor the weather, soil quality, soils saturation, LAD application rate, vegetation, and water quality at the Boe Ranch LAD area. The monitoring plan would include threshold conditions and levels that, if exceeded, would trigger changes in LAD operation. SMC would propose to the agencies six to 12 months prior to the construction of the Boe Ranch LAD system a monitoring plan that includes these additional components. The agencies would review and approve the plan prior to implementation. Additional baseline soil, vegetation, water, and climate data would have to be collected before LAD is implemented at the Boe Ranch.

B.1. Monitoring

B.1.1 Weather

SMC would establish a complete weather station at the Boe Ranch site to collect baseline climate information at least one year before LAD is initiated and during operations. The agencies and SMC would jointly locate this station. Data from the station would be used to develop water budgets and to plan irrigation schedules for the Boe Ranch LAD System. Precipitation, wind speed, and weather predictions would be used with soil moisture data to determine the appropriate amount and rate of water to be applied through the LAD system. These data would be used to prevent surface runoff, over-irrigation (*i.e.*, saturation) of soils, salinization of soils, and to maximize plant uptake of nitrogen. The agencies suggest that SMC use a real-time system capable of electronically relaying this information immediately to SMC.

B.1.2 Soils

The following sections provide conceptual details of the proposed monitoring plan for soils.

B.1.2.1 Soils Mapping and Physical Characteristics

To facilitate the proper location of lysimeters, moisture probes, and soils sampling sites, the variability of soils within each proposed center pivot and adjacent control site(s) would be assessed through an Order II soil survey. The Order II soil survey would describe the gradation and range of soil properties and clearly depict each soil unit on an appropriately-scaled map. The survey would also include the following soil parameters:

- Thickness of horizons
- Porosity
- Texture
- Coarse fragment content
- Moisture content
- Bulk density
- Estimate of field capacity
- Depth to water table
- Existing surficial cracks and fill slope bulges

All future soils information would be consistently presented and coupled with the Order II soil survey and map. The location and dimensions of any changes in existing or new major surficial cracks and fill slope bulges would be identified and mapped.

B.1.2.2 Baseline Soils Quality Data

Baseline soils samples would be collected according to soil types and horizons, down to a depth of at least five feet or to the lithic contact. Samples would be collected using standard sample collection and handling quality assurance/quality control procedures. Each sample would be analyzed for:

- Nitrite plus Nitrate nitrogen ($NO_2^- + NO_3^-$)
- Ammonium (NH^+_4)
- Total Kjeldahl Nitrogen (TKN)
- Total Organic Carbon (TOC)
- Sodium Adsorption Ratio (SAR)
- Saturated Paste Extract Electrical Conductivity (EC) and pH

These data would be used to assess the health and condition of LAD area soils, identify major and critical soil types, and assist in developing irrigation schedules.

B.1.2.3 Operational Soils Monitoring

SMC would submit, six to 12 months prior to the construction of the Boe Ranch LAD system, a detailed plan for the location, installation, and monitoring schedule of lysimeters and moisture probes. The plan would include SMC's proposed schedule and criteria for application of LAD. Soils data would be collected within and downgradient of the proposed LAD areas and established in similar reference areas not influenced by the LAD. These locations would represent the major soil units within each area covered by the center pivots and, if present, critical units that have the most limitations or would most likely be affected by operation of the LAD system (*e.g.*, high-permeability, large coarse rock fragment content, potential for mass wasting). These locations would accurately reflect the variability in landscape and soils, position relative to prevailing winds, probable drift from the pivots, and potential for surface runoff and shallow subsurface interflow. At least one soil moisture probe (or array) would be located beneath each center pivot.

The soil profiles would be sampled by soil horizon. All lysimeters, moisture probes, and soil sampling sites would be permanently staked for identification on the ground, and delineated on a map for regular monitoring during and after the life of the LAD.

The weather station, array of lysimeters, soil moisture probes, and soil sampling sites are intended to provide data for the accurate estimation of evapotranspiration (ET), uptake of nitrogen by native and introduced plant species, attenuation and export of nitrogen and salts, and the annual loading of nitrogen and salts to the ground water. Considerable variation in ET rates would occur over the 30-year period of LAD operation. Daily soil water monitoring would be conducted, so irrigation would be optimized to control percolation of LAD water below the root zone. Soil moisture probes would be calibrated to the soil's moisture characteristics and have the capability of defining moisture content throughout the soil profile. The agencies suggest that SMC use a real-time system capable of electronically relaying this information immediately to SMC.

B.1.2.4 LAD Application Rate and Soil Water

Denitrification (net loss of nitrogen from the system) is negligible at moisture levels below about two-thirds of the water-holding capacity but is appreciable in flooded soils (Stevenson 1982). To facilitate the gaseous loss of nitrogen from soil, the LAD irrigation rate would be adjusted to maintain 65 to 80 percent of saturation in the top 12 to 18 inches of the soil profile. Optimal soil moisture content would facilitate denitrification through maximization of soil moisture residence time in the root zone.

To maximize plant nitrogen uptake and minimize the potential for runoff and nitrogen leaching below the root zone, SMC would adjust daily the LAD water application rate based on addition to soil water from precipitation and depletion of soil water by ET.

A daily water budget would be constructed to track water moving into and out of the effective root zone. The water budget would be solved in terms of daily soil moisture depletion. The amount of irrigation applied per day would be less than or equal to the amount of soil moisture depleted the previous day. Daily water budgets would be based on:

- Soil moisture readings
- Predicted or actual rainfall
- Depth of root zone (*i.e.*, soil reservoir water storage capacity)

- Soil field capacity
- Status of SMC's water balance
- Amount of LAD evaporated
- Amount of LAD delivered to soil
- Soil salts monitoring
- Ground water monitoring

LAD water application rates would be reduced with precipitation and when actual ET is low. LAD water application rates would increase when there is no precipitation and actual ET is high.

The volume of water collected in all lysimeters would be measured and noted weekly. Samples would be regularly collected according to standard sample collection and handling procedures for the following analyses:

- $NO_2^- + NO_3^-$
- NH^+_4
- TKN
- Chloride
- Sulfate
- EC
- pH

The results of these analyses would be compared with ground water quality data to evaluate nitrogen utilization by plants and the effect of deep percolate on ground water. SMC could apply at greater than these rates if a problem with the water balance or soil salinity develops as long as water quality levels are below the threshold action levels established for the site.

B.1.3 Ground Water, Seeps, and Springs

SMC would propose a monitoring network that encompasses the full extent of the Boe Ranch LAD system to the East Boulder River. This network would be placed to ensure identification of water quality changes due to application of LAD and any leaks from the LAD storage pond.

Pairs of monitoring wells consisting of a shallow, glacial-layer well and a bedrock well would be located upgradient, within, and downgradient of the LAD area. The monitoring wells would be used to indicate whether an increasing trend of nitrogen or salts was occurring as a result of LAD.

Prior to the construction of the Boe Ranch LAD system, SMC would document the location and flow rate of seeps and springs downgradient of the Boe Ranch LAD area. SMC would propose for agency review and approval a list of seeps and springs to monitor. During the irrigation season, SMC would periodically perform visual inspections for new seeps and surface runoff caused by LAD and make appropriate adjustments to LAD application rates. SMC would document new seep location(s) using GPS coordinates, estimate the flow rate of the seep(s), and report the formation of new seeps to the agencies.

Monitoring wells and selected seeps and springs would be sampled at least three times annually (spring: March to April, summer: July to September, and fall/winter: November to January), according to standard sample collection and handling quality assurance/quality control procedures, and analyzed for the following parameters.

- $NO_2^- + NO_3^-$
- NH^+_4
- TKN
- Common ions (Ca, Mg, K, Na, Cl, SO_4, carbonate, bicarbonate, and hardness)
- EC
- pH

If newly identified seeps have sufficient volume to sample, they would also be sampled for these parameters.

B.1.4 LAD Storage Pond, Mason Ditch, and East Boulder River

The volume of water in the LAD storage pond would be measured and used in SMC's overall water balance calculations. SMC would include in its LAD operation plans contingencies for those times when a positive (excess) water budget exists due to precipitation or high water inflows at the East Boulder Mine.

The Mason Ditch and the East Boulder River would be sampled at least three times annually (spring: March to April, summer: July to September, and fall/winter: from November to January), according to standard sample collection and handling quality assurance/quality control procedures, and analyzed for the following parameters.

- Flow rate
- $NO_2^- + NO_3^-$
- NH^+_4
- TKN
- Common ions (Ca, Mg, K, Na, Cl, SO_4, carbonate, and bicarbonate)
- EC
- pH

The results of the Mason Ditch monitoring would allow the agencies to determine its effect on the quality of ground water flowing from the land application area to the East Boulder River. Flow information for both the Mason Ditch and the East Boulder River would be necessary to interpret the effect of land application on ground and surface water.

B.1.5 Vegetation

Vegetation would be sampled periodically to document plant community compositional changes and health over time. SMC would include vegetation management in its plan submitted to the agencies for review and approval.

B.1.6 Mass Wasting

SMC would not use center pivot 10 (P10) because of mass wasting concerns. CES (2008) recommends undertaking additional investigation to assess the soils' ability to absorb the design flow LAD capacity near center pivot P9. The agencies would recommend the same level of sampling near P4.

SMC would submit a plan that would identify conditions that favor slumping or mass wasting around center pivots P4, P9, and P10. In this plan, SMC would consider the effect of deep percolate (soil water) on slope stability within the Boe Ranch LAD area. SMC would perform regular slope stability inspections during operation of the LAD system and provide in its plan operational adjustments that could be made if conditions were identified that favor slumping or mass wasting around the center pivots or storage pond. A geotechnical specialist would look for visible signs of slope movement, soil failures, and other indications of deep-set slope instability annually for a period of three years. The need for further annual geotechnical inspections would be reviewed at that time.

The location and dimensions of major surficial cracks and fill slope bulges identified in the baseline survey would be monitored and any changes would be reported to the agencies. This information would be used to determine if surface cracks and fill slope bulges were the result of LAD activities. Surficial fractures that progressively widen and elongate, or surface cracks located above a prominent, recently-observed surface bulge would be considered an indication of slope failure. If the potential for instability raises concerns for public safety or the environment, SMC would develop corrective plans.

B.2. LAD Storage Pond High-Hazard Action Plan

SMC would prepare an Operations and Maintenance Plan and an Emergency Preparedness Plan for the high-hazard Boe Ranch LAD storage pond for review and approval by the Montana Department of Environmental Quality (DEQ). DEQ would consult with the Montana Department of Natural Resources and Conservation (DNRC) to ensure that the plans met the requirements of the Montana Dam Safety Act. SMC would also prepare a conceptual plan for reducing the volume of water in the LAD storage pond to less than 50 acre-feet at closure to eliminate the high-hazard classification. These plans would have to be submitted six to 12 months before the LAD storage pond is constructed.

B.3. LAD Pipeline Monitoring and Spill Contingency Plan

SMC would prepare for agency review and approval a Pipeline Monitoring and Spill Contingency Plan (PMSCP) for operation of the LAD supply pipeline from the East Boulder Mine. The plan would be submitted for approval by DEQ and the Gallatin National Forest (GNF) six to 12 months before the pipeline and LAD system are constructed.

B.4. Threshold Conditions, Action Levels, and Reporting

The primary concerns associated with the land application of mine water are the accumulation of nitrates and salts in soil and subsequent transport through ground water to the East Boulder River. The following threshold action or trigger levels would address these concerns.

The threshold action level for nitrogen in ground water would be 2 mg/L total inorganic nitrogen (TIN) above the ambient TIN concentration. This action level would identify over-application of LAD in wells upgradient of the LAD storage pond. The agencies may choose to select a seep as an alternate monitoring site to evaluate the application of LAD. The threshold action level for EC in ground water would be an increase of 20 percent above the baseline conditions. This action level would identify over-application of LAD in wells upgradient of the LAD storage pond. The agencies may choose to select a seep as an alternate monitoring site to evaluate the application of LAD.

If either of these threshold action levels were exceeded, SMC would immediately notify the agencies and take the appropriate measures to address the exceedance(s). SMC would identify in its plan several potential measures that would reduce nitrogen and salts loading from LAD. Potential action/contingency measures may include but are not limited to the following:

- Interseed with vegetation that is compatible with the surrounding ecosystem, adapted to local climatic conditions, and able to sequester larger amounts of nitrogen or tolerate the salts load.
- Mechanically remove aboveground plant biomass and standing litter in accessible areas.
- Manage livestock to facilitate the net removal of nitrogen.
- Periodically burn vegetation if it can be implemented safely under controlled conditions.
- Reduce the hydraulic load delivered to the LAD area to prevent seeps, erosion, and mass wasting.
- Reduce the nitrogen and salts load delivered to the LAD area. The adit and tailings waters should be monitored annually for EC and total dissolved solids (TDS) to provide advance warning of any salinity increase. Such monitoring would allow SMC to implement adaptive management actions to avoid concentrating salts in LAD area soils and vegetation when the tailings waters are disposed of at closure. SMC would supplement the frequency of its monitoring of salts in adit and tailings waters and make efforts to reduce the salts load and concentrations annually. SMC would include in each annual report the measures implemented and the resulting reductions in salts concentrations achieved during the past year.
- Improve nitrogen removal efficiency of the BTS.

- Implement a salts removal treatment system at the East Boulder Mine.
- Redesign portions of the LAD system to allow regular mechanical removal of plant biomass.

Some of these action/contingency plans may not be feasible at the Boe Ranch or would have other effects that may negate the benefits. Regardless of the action/contingency plans implemented, SMC would be required to perform monitoring and assessment of the LAD system to see if operational changes could be made that could influence monitoring results. Some additional actions include:

- If monitoring indicates that the concentrations of nitrates in ground water are above the threshold action level, the source of the increase cannot be resolved and approaches 7.5 mg/L, and concentrations of nitrates are measurable in the East Boulder River, SMC would have to apply for an MPDES permit.
- If the level of nitrates in the East Boulder River reaches 1 mg/L, then SMC would conduct annual monitoring of periphyton and macroinvertebrates in the East Boulder River above and below the Boe Ranch LAD.

SMC would submit to the agencies the results of monitoring at the end of the first two LAD seasons. If monitoring shows little effect, reporting may be changed to annual. Also, if monitoring suggests some constituents are not appearing in ground water after the first five years of operation of the Boe Ranch LAD facility, SMC may provide written documentation and request that those parameters be dropped from monitoring.

SMC would monitor the flow rate of the East Boulder River during operations. If the flow in the East Boulder River downstream of the Mason Ditch irrigation diversion drops below 3 cubic feet per second (cfs), SMC would have to dispose of some of the nitrogen load at the East Boulder Mine.

SMC would have to implement additional monitoring and mitigating measures if soil SAR concentrations in the Boe Ranch LAD area downgradient monitoring well increase two units above the Boe Ranch LAD storage pond water SAR concentrations.

If the LAD supply pipeline leaks or ruptures, SMC would sample the discharge and report to the agencies as directed in the PMSCP. A cleanup plan would have to be submitted in the PMSCP.

If the LAD storage pond develops a leak as indicated by downgradient ground water monitoring wells, a leak response plan would have to be submitted for agency review and approval.

Appendix C — Agency Water Quality & Quantity Analyses

This appendix contains spreadsheets used in the agencies' water quality and quantity analyses and two agency technical memorandums. The first technical memorandum addresses the projected nitrogen concentration decline in adit water when operations cease, and the second addresses projected nitrogen loading estimates to the Stillwater River from the off-shaft at post-closure.

TECHNICAL MEMORANDUM

July 21, 2010

To: Emily Corsi, Montana Environmental Policy Act Specialist

From: Lisa M. Boettcher, Reclamation Specialist

Re: Stillwater Mining Company (SMC) Projected Nitrogen Concentration Decline Curve

This memo describes the analysis performed to project the decline of nitrogen concentrations in adit water from workings that do not flood during closure and post-closure at the Stillwater and East Boulder mines. Other calculations have been made with respect to flooded workings and are included in the July 2010 technical memorandum discussing Off-Shaft Flooding at the Stillwater Mine.

At closure, the Stillwater Mine would dispose of approximately 35 million gallons (MG) of tailings waters from the Stillwater tailings impoundment, 45 MG of tailings waters from the Hertzler Ranch tailings impoundment, and up to 2,020 gpm of adit water. At closure, the East Boulder Mine would dispose of approximately 40 MG of tailings waters and up to 737 gpm of adit water. Adit water would discharge from both mines and need disposal following closure (*i.e.,* post-closure). If the concentrations of nitrogen in discharged waters at closure could be projected accurately, the agencies could then identify the length of time that closure treatment of adit water would be needed. The agencies could also identify the potential for, and the duration of, post-closure untreated water quality effects.

The Stillwater Mine changed its mining plan and suspended blasting in the east side workings in 2002. As a result of the suspension of blasting, a decline from 10.3 mg/L to less than 0.2 mg/L in nitrogen concentrations in east-side adit water has been observed from 2000 to present. The agencies believe that this 10-year decline in nitrogen concentrations measured in the east-side adit water would be representative of the rate of decline in concentrations that would occur during closure and into the post-closure period. The agencies have used these nitrogen concentration data to construct a mathematical model of the post-2002 decline and to project the concentrations of nitrogen in adit water that could be expected at closure and post-closure. The agencies have used standard regression analysis to develop a nitrogen decline curve. This type of analysis describes the nature of the relationship between the two variables of interest: nitrogen concentration in adit water and time. It is used to predict the value of the concentration of nitrogen in mg/L with time.

The assumptions underlying this analysis are:

- There is adequate similarity of characteristics (*e.g.* geology, hydrogeology, chemical composition of ore and waste rock, operations methodology, housekeeping practices, adit water background quality, tailings water quality, etc.) between the Stillwater and East Boulder mines that a direct comparison between the mines can be made;

- The nitrogen concentration decline observed by the ramping down and suspension of activity on the East Side of the Stillwater Mine is directly comparable to what can be expected at the Stillwater and East Boulder mines during closure; and

- The decline in nitrogen concentrations would continue at similar rates throughout closure and post-closure.

Background

Nitrogen compounds in mine waters originate from blasting agents used during mine development and production of ore. Blasting residue from incomplete detonations or spilled explosives contains concentrations of nitrogen that can dissolve into adit water. Tailings waters contain higher concentrations of nitrogen than adit water. Nitrogen concentrations are reduced in mine waste waters when treated in SMC's biological treatment systems (BTS) and during land application disposal. After treatment at the Stillwater Mine BTS, the ammonia-nitrogen and total Kjeldahl nitrogen (TKN)-nitrogen concentrations in adit water are at non-detectable concentrations (usually less than 0.1 mg/L). The nitrate plus nitrite-nitrogen concentrations in adit water are consistently less than 3 mg/L. Nitrogen concentrations in mine waters could become a water quality concern at closure when treated waters are discharged or post-closure when treatment would not be occurring.

Data Evaluation: East Boulder Mine

SMC has noted a reduction in nitrogen concentrations in adit waters when blasting ceased at the East Boulder Mine. Samples of untreated adit water and riser (tunnel) water were collected during two shutdown periods. The first occurred during a brief holiday shutdown December 23 through 25, Christmas 2001. During this time, no blasting occurred. The nitrogen (nitrate plus nitrite as N) concentration in untreated adit water decreased from 17 mg/L to 3 mg/L over three days (SMC 2002 memo M. Wolfe to B. Gilbert).

The second decrease in nitrogen levels occurred during the 2008 layoff shutdown, November 18 through December 1, 2008. During this time, no blasting occurred. Grab samples of riser water were taken and the nitrogen (nitrate plus nitrate as N) concentrations in untreated adit water decreased from 5.7 mg/L to as low as 0.23 mg/L over this period (SMC 2008 data obtained from M. Wolfe) (Figure 1). These data indicate an overall 66-percent decline in the concentration of nitrogen over a two-week period.

These two occurrences, although not statistically significant, provide support for a substantial decline in the nitrogen concentrations of untreated adit water over a short time frame after operational blasting ceases. These data would also suggest a decline in nitrogen concentration with the cessation of blasting at closure.

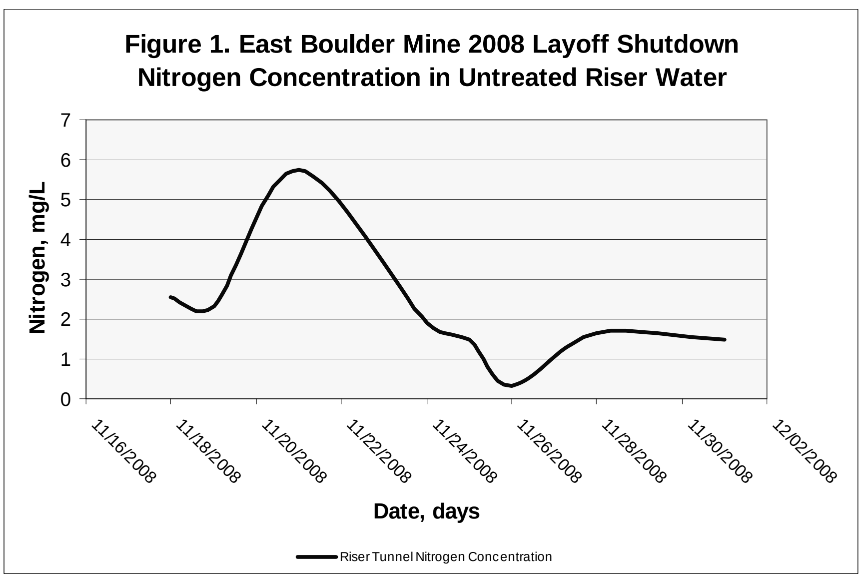

Figure 1 is a plot of the data from the two week 2008 Layoff Shutdown that occurred at the East Boulder Mine. The highest concentration was 5.7 mg/L on November 21, and the lowest concentration was 0.23 mg/L on November 26, 2008. These data represent a 66-percent decline in the concentration of nitrogen over a two-week period.

Data Evaluation: Stillwater Mine

SMC has collected nitrogen (nitrate plus nitrite-nitrogen, total ammonia-nitrogen, and TKN-nitrogen) data from untreated adit water flowing from the east-side workings of the Stillwater Mine since 1989 (Table 1). These data were collected during operations, and collection has continued after the suspension of blasting in 2002 through the present. SMC has collected samples at frequencies that varied from twice-annually to near-daily.

The nitrogen concentration in untreated east-side adit water reached a maximum of 10.3 mg/L in 2000 and has declined to less than 0.2 mg/L since September 2007 (Figure 2). Figure 2 shows that

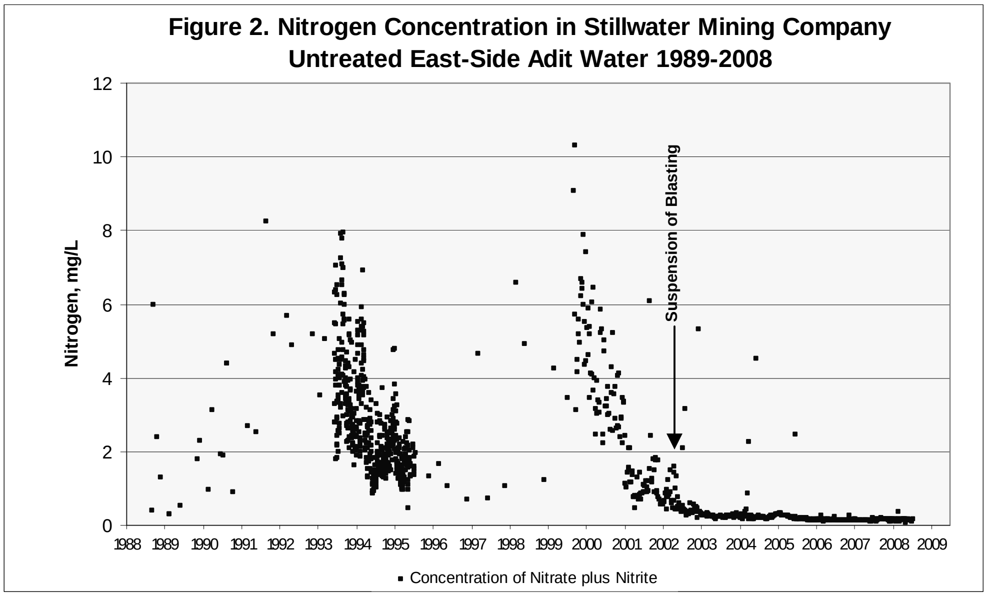

Figure 2 is a scatter plot of the concentrations of nitrogen in untreated adit water from the east-side workings from 1989 through 2008. The highest concentration was 10.3 mg/L in April 2000. The approximate date that blasting was suspended on Stillwater Mine's east side is indicated on the figure. These data are listed in Table 1.

the concentration of nitrogen in untreated adit water increased from less than 2 mg/L in 1989 to about 8 mg/L in 1993, then decreased to generally less than 2 mg/L through 1997. There are several factors that may be responsible for this decline in nitrogen concentration: 1) a change in the mine plan that altered the amount of production and development from the east side to the west side; 2) the completion of the tunnel beneath the Stillwater River connecting the east-side to the west-side workings that may have rerouted adit water; and 3) the continual progress SMC has made to upgrade its housekeeping and blast hole loading procedures to reduce waste.

Beginning in 1998, the nitrogen concentration increased again, reaching the highest concentration of 10.3 mg/L in April 2000. The nitrogen concentration then decreased, likely a result of the ramping down of east-side production until mid-2002 when blasting on the east side was suspended. The nitrogen concentrations have continued to decline since the suspension of blasting and have been less than 0.2 mg/L from fall 2007 through 2010. The agencies are satisfied that the dataset is sufficient to draw conclusions regarding the trend of nitrogen in adit water.

Method: Projecting the Decline of Nitrogen Concentration

To make predictions of the nitrogen concentrations at closure, the agencies fit an exponential decay curve to SMC's raw east-side water quality data. An exponential decay curve is a mathematical model that shows how the amount of a quantity decreases with time. The agencies chose an exponential decay curve to model the decrease because the quantity of nitrogen in SMC's adit water was seen to decay by a fixed percent at regular intervals of time.

The agencies then determined how accurately the decay curve could predict subsequent nitrogen concentrations. A high degree of accuracy would be required to project the nitrogen concentrations at closure. Statistical methods were used to measure the accuracy of the decay curve. The coefficient of determination, R^2, is the statistical metric the agencies used to measure the accuracy of the decay curve model.

A model curve that can exactly predict subsequent data has an R^2 coefficient equal to one. For example, if the first value of a data set is 438, the second value is 279, and the third value is 105, a model curve that has an R^2 coefficient equal to one will predict 279 as the second value and 105 as the third. Such a model curve would be very accurate at predicting subsequent values. If, however, a model curve cannot predict subsequent data accurately, the R^2 coefficient will be close to zero. In other words, this means that a model curve with an R^2 of 0.10 could not accurately predict the correct second and third data values. Most R^2 values reflect varying levels of success in predicting subsequent values and have values between one and zero.

When the agencies fit an exponential decay curve to the raw water quality data collected by SMC since 1999, many of the data points did not fall on the curve. If the data are sufficiently variable that many points do not fall on the curve, the R^2 coefficient will have a value closer to zero than one. The best fit exponential decay curve for all of the raw data from 2000 to present had an R^2 coefficient of 0.48. This R^2 coefficient value indicated that the initial decay curve did not successfully predict all of the subsequent data points. This initial decay curve did not have the necessary degree of accuracy and is not adequate to project the concentration of nitrogen at closure.

If the variability in the data were smoothed, more of the points would fall on the exponential decay curve model and provide a better fit of the data. A better fit would increase the success for predicting subsequent nitrogen concentrations. A method was needed that would preserve the integrity of the data yet reduce its variability. The agencies assumed that there was no small scale "structure" within the data causing the variability in the data. That is, it was assumed that the variability in the data is random and not a result of a specific undefined process or phenomenon. To smooth the data, the agencies chose to calculate the annual average nitrogen concentration for each year (Table 2).

This data smoothing approach solved two problems: it reduced the number of data points to be plotted, thus increasing the accuracy of the curve fit to these data, and it preserved the time-dependence of the data (x-intercepts), giving equal weight to each year, regardless of the number of samples collected per year (annually-averaged). Recall that SMC collected samples between 1989 and 2009 at frequencies that varied from twice-annually to near-daily. This technique has resulted in an over-emphasis of the data collected in some years compared to other years. Figure 3 is a plot of the annually averaged nitrogen concentrations in untreated adit water from the Stillwater Mine east-side workings from 1989 to 2008. It is visually apparent that this data-smoothing technique was effective in preserving the trend of the raw data set shown in Figure 2.

The agencies reviewed the annually-averaged data and identified an exponential decay trend that began in the year 2000 and extended through 2008. The agencies interpreted the break in the slope of the data at year 2000 to correspond with the ramping down of production prior to suspension of blasting at Stillwater Mine's east side. It is reasonable to expect that a ramping down of production would occur at both the Stillwater and East Boulder mines as closure is approached. Based on the shape of the plotted data, the agencies chose the year 2000 as an appropriate starting point to model the reduction in nitrogen concentration at closure.

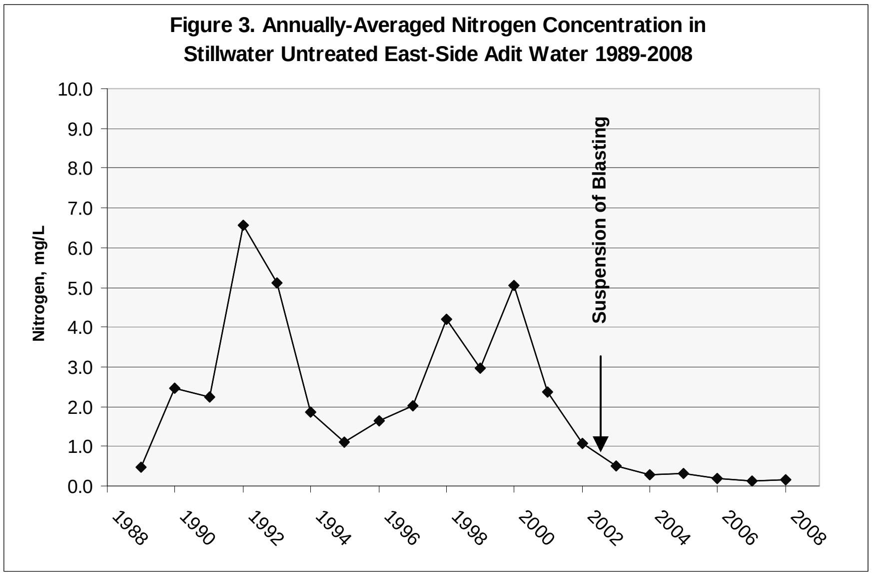

Figure 3 is a plot of the annually averaged concentrations of nitrogen in untreated adit water from the east-side workings from 1989 through 2008. The approximate date that blasting was suspended on Stillwater Mine's east side is indicated on the figure. These data are listed in Table 2.

The agencies fit an exponential decay curve $y = 3.9801\ e^{-0.0348x}$ to the annually-averaged data from 2000 to 2008, where x is the time in months and y is the nitrogen concentration in mg/L. The coefficient of determination (R^2) calculated for the exponential decay curve model was 0.93, indicating excellent predictability of subsequent nitrogen concentrations within this annually-averaged data set. This exponential decay curve model derived from the east-side data could be used to calculate the future rate of nitrogen decay in untreated adit water from the west side.

Closure Nitrogen Decline Curve Calculation

The agencies reviewed SMC's current operational concentration of nitrogen in untreated adit water from the west-side workings and assumed that nitrogen concentrations would be similar at the end of mine life. The 2009 untreated adit water concentrations average 40 to 45 mg/L nitrogen, whereas the highest concentration on the east-side workings from 1989 to 2009 was about 10 mg/L. The agencies extrapolated the exponential decay curve model to match the expected maximum concentration of untreated adit water at closure, *i.e.*, about 40 to 45 mg/L nitrogen. The equation for the decay curve is then $y = 37.456\ e^{-0.0348x}$, where x is the time in months and y is the nitrogen concentration in mg/L (Figure 4). The modeled closure nitrogen decline curve has an R^2 value of 0.97, indicating that the fit of the values used to extrapolate this curve are similar to the fit of the annually-averaged data curve.

How to Use the Nitrogen Decline Curve

Projections for the length of time that closure water treatment would be necessary are based on the nitrogen load (*i.e.*, concentration of nitrogen and adit flow rate). For example, if the untreated concentration of adit water when closure commences at the Stillwater Mine was 34.9 mg/L at a flow rate of 400 gpm, then the resulting nitrogen load would be 167.5 pounds of nitrogen per day (lbs-N/day). This load exceeds the Stillwater Mine MPDES permit nitrogen load limit of 100 lbs-N/day. Treatment would be required until the permit load limit could be met. That is, at 400 gpm, water treatment would be required until the adit water nitrogen concentration is less than or equal to 20.8 mg/L. Using the Projected Nitrogen Concentration Decline Curve, the concentration 34.9 mg/L occurs at about two months, and the concentration 20.8 occurs at about 17 months. For this example, the projected length of time needed to treat adit water is about 15 months.

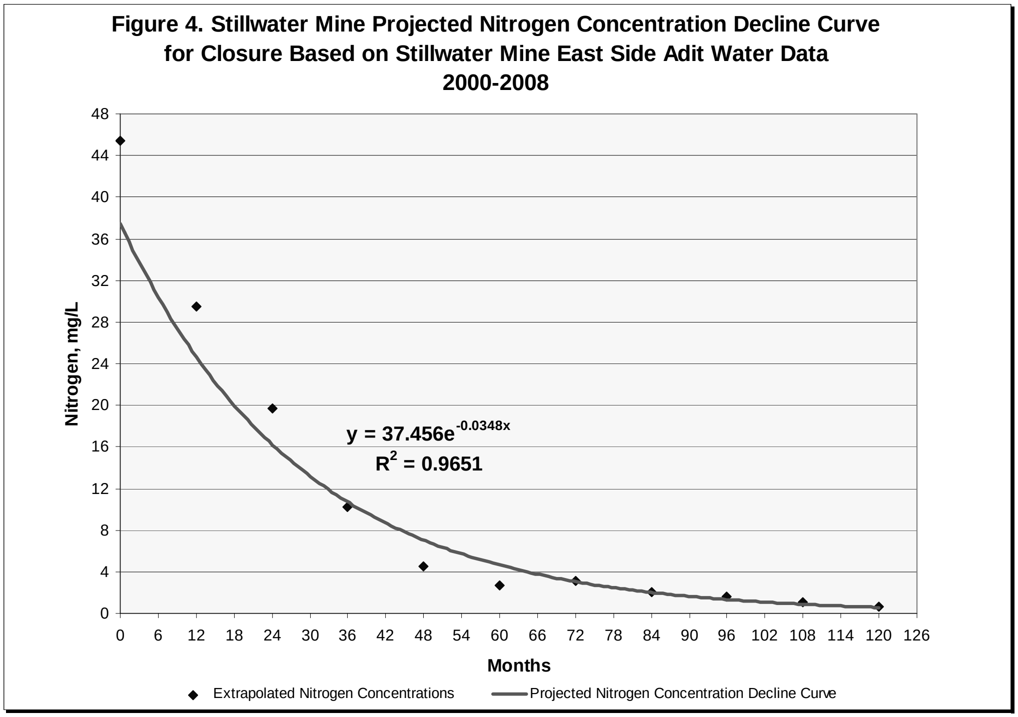

Figure 4 is the projected decline in the nitrogen concentration of untreated adit water at closure based upon data collected from the Stillwater Mine east-side workings from 2000 through 2008. The diamonds are the nitrogen values extrapolated from 2000 to 2008 east-side adit water data to compare with untreated 2009 operational nitrogen concentrations. These extrapolated values are inclusive of the period of time in which Stillwater began to ramp down production before blasting was suspended. The curve is the exponential nitrogen decay model based on these data. The data for this model curve are listed in Table 3.

Conclusion

The agencies believe that the decline in nitrogen concentration observed at the east-side workings from 2000 to 2008 is representative of the decline in concentration that would occur at closure for adit water flowing through workings that do not flood at both the Stillwater and East Boulder mines. The agencies used these nitrogen concentration data to construct a mathematical model of the nitrogen decline and to project the concentrations of nitrogen in adit water that could be expected at closure and during post-closure.

The reduction in nitrogen concentration can be represented by the equation $y = 37.456\, e^{-0.0348x}$, where x is the time in months and y is the nitrogen concentration in mg/L (Figure 4). It should be noted for prediction purposes that this model is based on data inclusive of the period when east-side blasting was still occurring but east-side production was ramping down. The time frame projected by this model for the decline of nitrogen concentrations will, therefore, be conservative. These nitrogen concentration projections indicate the maximum time needed from the cessation of blasting at closure for adit water nitrogen levels to decline to a specific concentration. This model also provides nitrogen concentration projections that can be used in concert with adit flow rate to estimate the maximum amount of time water treatment would be needed at closure.

References

Box, G.E.P., W. G. Hunter, and J. S. Hunter. 1978. Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building. John Wiley & Sons, Inc. New York. 653 pages.

Gilbert, R. O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold. New York. 320 pages.

Table 1. Nitrate + Nitrite-Nitrogen Concentration Raw Data in Untreated East-Side Adit Water at the Stillwater Mine, April 1989 through February 2009.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
04/03/89	0.4	01/27/94	2.88	04/04/94	5.57
04/11/89	6	01/28/94	2.43	04/05/94	5.59
05/09/89	2.4	01/30/94	2.16	04/06/94	6.29
06/15/89	1.31	01/31/94	1.84	04/07/94	6.25
09/07/89	0.29	02/01/94	2	04/08/94	6
09/07/89	0.31	02/02/94	4.75	04/11/94	3.9
12/20/89	0.52	02/02/94	2.55	04/12/94	3.78
06/05/90	1.81	02/03/94	4.1	04/13/94	3.54
06/25/90	2.28	02/04/94	4.07	04/14/94	3.43
09/16/90	0.98	02/06/94	2.56	04/15/94	3.3
10/25/90	3.12	02/07/94	3.42	04/18/94	4
01/14/91	1.92	02/08/94	3.51	04/19/94	3.84
02/06/91	1.88	02/09/94	3.33	04/20/94	4.24
03/09/91	4.38	02/10/94	4.21	04/21/94	4.31
03/09/91	4.4	02/11/94	4.52	04/22/94	4.47
05/13/91	0.9	02/13/94	3.79	04/25/94	3.32
09/28/91	2.7	02/14/94	2.48	04/26/94	3.55
12/20/91	2.54	02/15/94	3.98	04/27/94	2.7
03/19/92	8.23	02/16/94	4.34	04/28/94	4.68
05/22/92	5.2	02/17/94	5.05	04/29/94	3.74
09/29/92	5.67	02/18/94	4.49	05/02/94	3
11/19/92	4.89	02/20/94	3.78	05/03/94	2.25
06/02/93	5.2	02/22/94	2.77	05/04/94	2.75
08/19/93	3.51	02/23/94	2.61	05/05/94	3.26
10/02/93	5.04	02/24/94	3.28	05/06/94	2.31
01/02/94	2.79	02/25/94	4.49	05/09/94	2.78
01/03/94	3.3	03/02/94	7.26	05/10/94	3.91
01/04/94	2.79	03/03/94	7.92	05/11/94	4.4
01/05/94	5.48	03/04/94	6.02	05/12/94	4.38
01/06/94	6.32	03/07/94	3.2	05/13/94	3.12
01/07/94	4.66	03/08/94	7.78	05/16/94	2.63
01/09/94	3.96	03/10/94	6.52	05/16/94	2.28
01/10/94	3.8	03/11/94	6.65	05/17/94	3.08
01/11/94	7.05	03/14/94	3.6	05/18/94	2.38
01/12/94	6.38	03/15/94	4.08	05/19/94	3.41
01/13/94	4.5	03/16/94	4.54	05/20/94	4.28
01/14/94	4.5	03/17/94	4.95	05/23/94	3.33
01/16/94	2.8	03/18/94	7.08	05/24/94	2.1
01/17/94	1.8	03/21/94	2.95	05/25/94	5.2
01/18/94	4.14	03/22/94	4.07	05/26/94	5.59
01/19/94	5.44	03/23/94	5.72	05/27/94	3.95
01/20/94	6.51	03/24/94	6.98	05/31/94	5.02
01/21/94	6.25	03/25/94	7.94	06/01/94	3.65
01/23/94	2.94	03/28/94	4.74	06/02/94	3.25
01/24/94	2.19	03/29/94	5.46	06/03/94	2.82
01/25/94	3.33	03/30/94	6.97	06/06/94	3.69
01/26/94	3.36	03/31/94	5.55	06/07/94	3.11

Table 1, continued.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
06/09/94	4.96	08/23/94	3.8	11/01/94	2.48
06/10/94	3.17	08/24/94	3.41	11/02/94	2.41
06/13/94	2.62	08/25/94	2.84	11/03/94	3.2
06/14/94	2.43	08/26/94	2.8	11/04/94	3.76
06/15/94	3.04	08/26/94	3.51	11/07/94	1.69
06/16/94	2.93	08/29/94	2.53	11/08/94	1.28
06/17/94	2.37	08/30/94	2.36	11/09/94	1.33
06/20/94	2.69	08/31/94	1.87	11/10/94	1.54
06/21/94	2.74	09/01/94	2	11/11/94	1.78
06/22/94	2.94	09/02/94	2.14	11/14/94	2.11
06/23/94	2.48	09/06/94	2.76	11/15/94	2.65
06/24/94	2.58	09/07/94	2.29	11/16/94	2.7
06/27/94	2.22	09/08/94	2.27	11/17/94	2.5
06/28/94	2.19	09/09/94	2.15	11/18/94	2.7
06/29/94	2.15	09/12/94	3.3	11/21/94	2.57
06/30/94	2.66	09/13/94	5.92	11/22/94	1.74
07/01/94	1.98	09/14/94	4.38	11/23/94	2.23
07/05/94	1.64	09/15/94	4.04	11/28/94	2.77
07/07/94	2.4	09/16/94	4.88	11/29/94	3.58
07/08/94	3.02	09/19/94	5.28	11/30/94	2.86
07/11/94	2.67	09/20/94	5.4	12/01/94	3.11
07/12/94	2.45	09/21/94	5.58	12/02/94	2.71
07/13/94	4.14	09/22/94	6.9	12/05/94	2.9
07/14/94	4.5	09/23/94	5.38	12/06/94	2.17
07/15/94	2.08	09/26/94	3.51	12/07/94	1.82
07/18/94	2.07	09/27/94	3.65	12/08/94	1.8
07/19/94	2.03	09/28/94	3.91	12/09/94	1.93
07/20/94	2.04	09/29/94	3.75	12/12/94	1.52
07/21/94	2.04	09/30/94	4.23	12/13/94	1.42
07/22/94	2.09	10/03/94	3.58	12/14/94	2
07/25/94	2.12	10/04/94	5.49	12/15/94	2.56
07/26/94	3.15	10/05/94	4.74	12/16/94	3.38
07/27/94	3.63	10/06/94	3.71	12/19/94	2.79
07/28/94	2.82	10/07/94	2.86	12/20/94	2.36
07/29/94	2.59	10/10/94	4.02	12/21/94	2.17
08/01/94	1.9	10/11/94	4.63	12/22/94	1.79
08/02/94	2.08	10/12/94	5.15	12/27/94	1.25
08/03/94	2.65	10/13/94	4.53	12/28/94	1.13
08/04/94	2.39	10/13/94	5.24	12/29/94	1.1
08/05/94	2.41	10/14/94	4.46	12/30/94	0.93
08/08/94	5.3	10/17/94	2.28	01/03/95	0.85
08/09/94	3.8	10/18/94	2.03	01/04/95	0.85
08/10/94	5.16	10/19/94	2.43	01/05/95	0.94
08/11/94	4.88	10/20/94	2.49	01/06/95	1.16
08/12/94	5.52	10/21/94	2.45	01/09/95	1.37
08/15/94	3.99	10/24/94	3.96	01/10/95	1.36
08/16/94	4.65	10/25/94	2.85	01/11/95	1.4
08/17/94	3.88	10/26/94	2.1	01/12/95	1.49
08/18/94	3.63	10/27/94	2.22	01/13/95	1.16
08/19/94	3.72	10/28/94	2.23	01/16/95	0.97
08/22/94	3.76	10/31/94	1.84	01/17/95	1.08

Table 1, continued.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
01/18/95	1.07	03/31/95	2.43	06/14/95	2.26
01/19/95	1.02	04/03/95	1.34	06/14/95	2.49
01/20/95	1.15	04/04/95	1.35	06/15/95	2.53
01/23/95	1.28	04/05/95	1.7	06/16/95	1.6
01/24/95	1.83	04/06/95	3.71	06/19/95	2.61
01/25/95	1.64	04/07/95	2.03	06/20/95	2.83
01/26/95	1.18	04/10/95	1.29	06/21/95	2.3
01/27/95	1.03	04/11/95	1.49	06/22/95	2.57
01/30/95	1.03	04/12/95	1.78	06/23/95	2.13
01/31/95	1.14	04/13/95	1.75	06/26/95	1.92
02/01/95	1.32	04/17/95	1.34	06/27/95	1.48
02/02/95	1.24	04/18/95	1.42	06/28/95	2.82
02/03/95	1.19	04/19/95	1.5	06/29/95	2.25
02/06/95	1.83	04/20/95	1.7	06/30/95	2.49
02/07/95	3.28	04/21/95	1.66	07/03/95	2.17
02/08/95	3.03	04/24/95	1.93	07/05/95	1.77
02/09/95	1.74	04/25/95	2.6	07/06/95	2.15
02/10/95	2.8	04/26/95	2.08	07/07/95	3
02/10/95	2.8	04/27/95	2.66	07/10/95	2.19
02/13/95	2	04/28/95	2.74	07/11/95	2.19
02/14/95	2.22	05/01/95	1.71	07/12/95	2.24
02/15/95	1.97	05/02/95	1.49	07/13/95	2.44
02/16/95	1.85	05/03/95	1.83	07/14/95	3.12
02/17/95	1.55	05/04/95	1.38	07/17/95	2.9
02/21/95	1.36	05/05/95	1.26	07/18/95	3.41
02/22/95	1.51	05/08/95	1.58	07/19/95	2.74
02/23/95	1.63	05/09/95	1.67	07/20/95	4.74
02/24/95	1.42	05/10/95	1.76	07/21/95	2.76
02/27/95	1.59	05/11/95	1.74	07/24/95	2.3
02/28/95	1.98	05/12/95	1.52	07/25/95	2.65
03/01/95	1.69	05/15/95	2.44	07/26/95	3.22
03/02/95	1.47	05/16/95	2.21	07/27/95	2.58
03/03/95	2.43	05/17/95	2.91	07/28/95	2.32
03/06/95	2.83	05/18/95	1.93	07/31/95	2.34
03/07/95	2.38	05/19/95	1.7	08/01/95	2.05
03/08/95	3	05/22/95	2.07	08/02/95	4.79
03/09/95	2.44	05/23/95	2.49	08/03/95	3.81
03/10/95	1.52	05/24/95	2.09	08/04/95	3.08
03/13/95	1.71	05/25/95	2.36	08/07/95	2.8
03/14/95	1.71	05/26/95	2	08/08/95	1.4
03/15/95	1.53	05/30/95	1.66	08/09/95	1.8
03/16/95	1.4	05/31/95	2.32	08/10/95	2.42
03/17/95	1.46	06/01/95	1.9	08/11/95	3.57
03/20/95	2.13	06/02/95	2.05	08/14/95	1.95
03/21/95	2.77	06/05/95	1.47	08/15/95	2.04
03/22/95	2.12	06/06/95	1.49	08/16/95	2.77
03/23/95	1.9	06/07/95	1.52	08/17/95	3.25
03/24/95	1.88	06/08/95	2.01	08/18/95	2.34
03/27/95	1.41	06/09/95	2.34	08/21/95	1.57
03/28/95	1.61	06/12/95	2.28	08/22/95	1.67
03/29/95	1.56	06/13/95	2.28	08/23/95	1.49

Table 1, continued.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
08/24/95	1.71	11/02/95	1.87	06/11/98	1.07
08/25/95	1.74	11/03/95	1.49	09/23/98	6.57
08/28/95	1.61	11/06/95	1.49	12/14/98	4.92
08/29/95	2.08	11/07/95	1.65	06/23/99	1.22
08/30/95	1.95	11/08/95	2.39	09/28/99	4.26
08/31/95	1.66	11/09/95	2.1	01/28/00	3.47
09/01/95	1.4	11/10/95	1.93	03/31/00	9.09
09/05/95	1.27	11/13/95	1.75	04/07/00	10.3
09/06/95	1.26	11/15/95	1.94	04/14/00	5.73
09/07/95	1.55	11/16/95	1.86	04/21/00	3.11
09/08/95	1.3	11/17/95	1.81	04/28/00	4.49
09/11/95	1.46	11/20/95	1.81	05/05/00	4.14
09/12/95	1.92	11/21/95	2.23	05/12/00	5.58
09/13/95	1.56	11/22/95	2.54	05/19/00	5.2
09/14/95	2.1	11/27/95	1.62	05/26/00	4.95
09/15/95	2.36	11/28/95	2.51	06/02/00	6.23
09/18/95	2.18	11/29/95	2.87	06/09/00	6.68
09/19/95	1.93	11/30/95	1.81	06/16/00	6.59
09/20/95	1.57	12/01/95	1.1	06/23/00	6.4
09/21/95	1.37	12/04/95	1.24	06/28/00	7.87
09/22/95	1.26	12/05/95	0.48	06/30/00	6
09/25/95	1.1	12/06/95	1.57	07/07/00	5.51
09/26/95	1.35	12/07/95	2.15	07/14/00	4.34
09/27/95	1.3	12/08/95	0.96	07/21/00	4.45
09/28/95	1.11	12/11/95	1.73	07/28/00	7.4
09/29/95	1.44	12/12/95	1.82	08/04/00	5.36
09/29/95	1.41	12/13/95	2.83	08/11/00	5.88
09/29/95	1.17	12/14/95	2.03	08/18/00	4.63
10/02/95	1	12/15/95	1.59	08/25/00	3.46
10/03/95	0.99	12/18/95	1.82	08/31/00	5.4
10/04/95	1.04	12/19/95	1.75	09/01/00	5.19
10/05/95	0.95	12/20/95	2.02	09/08/00	4.12
10/06/95	1.52	12/21/95	1.62	09/15/00	4.09
10/09/95	1.44	12/22/95	1.67	09/22/00	6.04
10/10/95	1.78	12/27/95	1.34	09/29/00	3.64
10/11/95	1.85	12/28/95	1.37	10/06/00	6.45
10/12/95	1.64	12/29/95	1.32	10/13/00	3.99
10/13/95	2.26	01/16/96	2.18	10/20/00	3.15
10/16/95	1.27	01/17/96	2.09	10/27/00	2.46
10/17/95	0.97	01/29/96	1.6	11/02/00	3.93
10/18/95	1.33	01/30/96	1.54	11/03/00	3.04
10/19/95	1.1	01/31/96	1.86	11/17/00	3.38
10/20/95	1.35	02/01/96	1.47	11/24/00	3.07
10/23/95	1.24	02/02/96	1.36	12/01/00	3.32
10/24/95	1.17	02/14/96	1.96	12/08/00	5.84
10/25/95	1.79	06/20/96	1.34	12/15/00	5.22
10/26/95	1.74	09/23/96	1.67	12/22/00	5.31
10/27/95	2.06	12/13/96	1.08	12/29/00	2.22
10/30/95	1.29	06/13/97	0.7	01/05/01	2.46
10/31/95	1.22	09/25/97	4.67	01/12/01	4.73
11/01/95	1.48	12/30/97	0.72	01/19/01	5.03

Table 1, continued.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
01/26/01	3.21	01/18/02	1.1	12/13/02	0.51
02/02/01	3.22	01/25/02	0.91	12/20/02	0.76
02/09/01	3.42	02/01/02	1.05	12/27/02	0.59
02/16/01	3.76	02/08/02	0.91	01/03/03	0.47
02/23/01	3	02/15/02	1.19	01/10/03	0.43
03/08/01	3.04	02/22/02	1.04	01/17/03	0.35
03/16/01	2.59	03/01/02	0.89	01/24/03	0.37
03/23/01	4.28	03/08/02	1.21	01/31/03	2.09
03/30/01	3.59	03/15/02	0.94	02/07/03	0.53
04/06/01	2.56	03/22/02	1.54	02/14/03	0.43
04/12/01	5.23	03/28/02	6.08	02/21/03	3.15
04/20/01	3.56	04/05/02	2.41	02/28/03	0.4
04/27/01	3.75	04/12/02	1.27	03/03/03	0.25
05/04/01	2.88	04/19/02	1.18	03/07/03	0.36
05/11/01	2.64	04/26/02	1.79	03/14/03	0.33
05/18/01	2.7	05/03/02	0.91	03/21/03	0.36
05/25/01	4.05	05/10/02	1.5	03/28/03	0.31
06/01/01	4.12	05/17/02	1.77	04/04/03	0.37
06/08/01	2.67	05/24/02	1.83	04/11/03	0.35
06/15/01	2.39	05/31/02	0.86	04/17/03	0.6
06/22/01	2.92	06/06/02	0.93	04/25/03	0.41
06/29/01	2.89	06/07/02	1.75	05/02/03	0.38
07/06/01	3.47	06/14/02	0.76	05/09/03	0.34
07/13/01	2.24	06/21/02	0.69	05/16/03	0.57
07/20/01	3.35	06/28/02	0.71	05/30/03	0.45
07/23/01	3.33	07/05/02	0.58	06/06/03	0.49
07/27/01	2.43	07/12/02	0.6	06/09/03	0.37
08/03/01	1.14	07/19/02	0.62	06/13/03	0.36
08/10/01	1.03	07/26/02	0.58	06/20/03	0.46
08/17/01	1.03	08/02/02	0.62	06/27/03	0.2
08/24/01	1.42	08/09/02	0.62	07/03/03	5.32
08/31/01	1.5	08/16/02	0.67	07/11/03	0.38
09/04/01	2.08	08/23/02	0.88	07/18/03	0.35
09/07/01	1.55	08/30/02	0.97	07/25/03	0.33
09/14/01	2.08	09/03/02	0.43	08/01/03	0.29
09/21/01	1.18	09/06/02	0.76	08/08/03	0.28
09/28/01	1.17	09/13/02	0.78	08/15/03	0.29
10/05/01	1.46	09/20/02	1.24	08/22/03	0.25
10/12/01	1.36	09/27/02	0.82	08/29/03	0.26
10/19/01	0.77	10/04/02	1.49	09/05/03	0.25
10/26/01	0.76	10/11/02	0.91	09/12/03	0.25
11/02/01	0.81	10/18/02	0.67	09/18/03	0.32
11/07/01	0.48	10/25/02	0.6	09/19/03	0.23
11/16/01	0.78	11/01/02	0.46	09/26/03	0.32
11/23/01	1.3	11/08/02	1.42	10/03/03	0.3
11/30/01	0.8	11/11/02	0.65	10/10/03	0.27
12/07/01	0.7	11/15/02	1.58	10/17/03	0.26
12/14/01	1.42	11/22/02	1.01	10/24/03	0.28
12/21/01	0.82	11/27/02	0.44	10/31/03	0.25
12/28/01	0.86	12/06/02	1.32	11/07/03	0.23
01/04/02	0.71	12/10/02	0.44	11/11/03	0.26

Table 1, continued.

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
11/14/03	0.22	10/22/04	0.17	09/23/05	0.25
11/21/03	0.27	10/29/04	2.27	09/30/05	0.26
11/26/03	0.22	11/05/04	0.22	10/07/05	0.26
12/05/03	0.2	11/12/04	0.22	10/14/05	0.27
12/12/03	0.18	11/19/04	0.28	10/21/05	0.28
12/19/03	0.2	11/26/04	0.19	10/28/05	0.25
12/26/03	0.24	11/30/04	0.17	11/04/05	0.24
01/02/04	0.23	12/03/04	0.22	11/07/05	0.22
01/09/04	0.24	12/10/04	0.18	11/11/05	0.23
01/16/04	0.24	12/17/04	0.2	11/18/05	0.23
01/23/04	0.24	12/24/04	0.2	11/23/05	0.21
01/30/04	0.25	12/31/04	0.21	12/02/05	0.22
02/06/04	0.24	01/07/05	4.51	12/09/05	0.2
02/13/04	0.22	01/14/05	0.23	12/16/05	0.19
02/20/04	0.21	01/21/05	0.25	12/23/05	0.21
02/27/04	0.23	01/28/05	0.22	12/30/05	0.18
03/05/04	0.23	02/04/05	0.21	01/06/06	2.47
03/12/04	0.21	02/11/05	0.2	01/13/06	0.24
03/19/04	0.21	02/18/05	0.24	01/20/06	0.18
03/26/04	0.25	02/25/05	0.23	01/27/06	0.18
04/02/04	0.25	03/04/05	0.2	02/03/06	0.18
04/08/04	0.24	03/11/05	0.22	02/10/06	0.18
04/16/04	0.27	03/18/05	0.19	02/17/06	0.18
04/23/04	0.23	03/25/05	0.2	02/24/06	0.2
04/30/04	0.25	04/01/05	0.21	03/03/06	0.18
05/07/04	0.23	04/08/05	0.18	03/10/06	0.19
05/14/04	0.26	04/15/05	0.18	03/17/06	0.19
05/21/04	0.22	04/22/05	0.21	03/24/06	0.17
05/28/04	0.3	04/29/05	0.21	03/31/06	0.17
06/04/04	0.21	05/06/05	0.21	04/07/06	0.17
06/11/04	0.22	05/13/05	0.23	04/14/06	0.18
06/18/04	0.25	05/20/05	0.25	04/21/06	0.19
06/18/04	0.27	05/27/05	0.22	04/28/06	0.17
06/25/04	0.34	06/03/05	0.23	05/05/06	0.14
07/02/04	0.25	06/03/05	0.19	05/12/06	0.15
07/09/04	0.24	06/10/05	0.23	05/19/06	0.14
07/16/04	0.25	06/17/05	0.28	05/26/06	0.13
07/23/04	0.24	06/24/05	0.27	05/31/06	0.17
07/30/04	0.27	07/01/05	0.27	06/02/06	0.13
08/06/04	0.21	07/08/05	0.29	06/09/06	0.13
08/13/04	0.3	07/15/05	0.3	06/16/06	0.14
08/20/04	0.2	07/22/05	0.3	06/23/06	0.14
08/27/04	0.18	07/29/05	0.29	06/30/06	0.14
09/03/04	0.23	08/05/05	0.3	07/07/06	0.17
09/10/04	0.24	08/12/05	0.32	07/14/06	0.13
09/17/04	0.23	08/19/05	0.33	07/21/06	0.13
09/20/04	0.25	08/26/05	0.3	07/28/06	0.12
09/24/04	0.37	08/31/05	0.28	08/04/06	0.14
10/01/04	0.42	09/02/05	0.28	08/11/06	0.18
10/08/04	0.25	09/09/05	0.27	08/18/06	0.15
10/15/04	0.88	09/16/05	0.25	08/25/06	0.13

Table 1, continued. *A negative number indicates a non-detectable concentration at that limit.*

Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L	Sample Date	$NO_2 + NO_3$, mg/L
09/01/06	0.14	07/06/07	0.14	05/09/08	0.15
09/08/06	0.15	07/13/07	0.14	05/16/08	0.16
09/15/06	0.26	07/20/07	0.14	05/23/08	0.15
09/16/06	0.17	07/27/07	0.15	05/30/08	0.17
09/22/06	0.15	08/03/07	0.16	06/06/08	0.16
09/29/06	0.14	08/10/07	0.12	06/13/08	0.15
10/06/06	0.11	08/17/07	0.13	06/20/08	0.14
10/13/06	0.15	08/24/07	0.13	06/27/08	0.1
10/20/06	0.14	08/31/07	0.13	06/27/08	0.13
10/27/06	0.13	09/07/07	0.12	06/30/08	0.17
11/03/06	0.14	09/14/07	0.13	07/04/08	0.16
11/10/06	0.15	09/18/07	0.14	07/04/08	0.1
11/22/06	0.13	09/21/07	0.13	07/11/08	0.16
11/27/06	0.15	09/28/07	0.12	07/11/08	0.1
12/01/06	0.13	10/05/07	0.13	07/18/08	0.16
12/08/06	0.13	10/12/07	0.13	07/25/08	0.16
12/15/06	0.12	10/19/07	0.13	08/01/08	0.17
12/22/06	0.13	10/26/07	0.13	08/08/08	0.12
12/29/06	0.14	11/02/07	0.12	08/15/08	-0.05
01/05/07	0.15	11/09/07	0.14	08/22/08	0.09
01/12/07	0.14	11/12/07	0.13	08/29/08	0.16
01/19/07	0.22	11/16/07	0.12	09/05/08	0.12
01/26/07	0.14	11/23/07	0.14	09/12/08	0.15
02/02/07	0.14	11/30/07	0.14	09/14/08	0.36
02/09/07	0.13	12/07/07	0.14	09/19/08	0.15
02/16/07	0.12	12/14/07	0.14	09/26/08	0.1
02/23/07	0.13	12/21/07	0.12	10/03/08	0.14
03/02/07	0.12	12/28/07	0.1	10/10/08	0.15
03/09/07	0.14	01/04/08	0.11	10/17/08	0.14
03/16/07	0.13	01/11/08	0.14	10/24/08	0.18
03/23/07	0.12	01/18/08	0.21	10/31/08	0.18
03/30/07	0.12	01/25/08	0.16	11/07/08	0.15
04/06/07	0.12	02/01/08	0.15	11/14/08	0.16
04/13/07	0.14	02/08/08	0.14	11/20/08	0.17
04/20/07	0.13	02/15/08	0.16	11/21/08	0.16
04/27/07	0.13	02/22/08	0.1	11/26/08	0.16
05/04/07	0.13	02/29/08	0.12	12/03/08	0.05
05/11/07	0.13	03/07/08	0.16	12/10/08	0.13
05/18/07	0.13	03/14/08	0.17	12/17/08	0.14
05/25/07	0.14	03/20/08	0.16	12/23/08	0.15
06/01/07	0.14	03/28/08	0.15	12/31/08	0.14
06/05/07	0.15	04/04/08	0.21	01/07/09	0.13
06/08/07	0.28	04/11/08	0.16	01/14/09	0.13
06/15/07	0.14	04/18/08	0.16	01/21/09	0.12
06/22/07	0.14	04/25/08	0.17	01/28/09	0.11
06/29/07	0.13	05/02/08	0.16	02/04/09	0.15

Table 2. Annually-Averaged Nitrogen Concentrations in Untreated Adit Water from the Stillwater Mine East-Side Workings, 1989-2009.

Year	Annually-Averaged Nitrogen Concentration, mg/L
1989	0.46
1990	2.47
1991	2.23
1992	6.56
1993	5.12
1994	1.86
1995	1.09
1996	1.65
1997	2.03
1998	4.19
1999	2.98
2000	5.04
2001	2.38
2002	1.07
2003	0.50
2004	0.29
2005	0.32
2006	0.20
2007	0.14
2008	0.15

Table 3. Extrapolated Nitrogen Concentrations in Untreated Adit Water Used to Calculate the Nitrogen Decline at the Stillwater Mines at Closure.

Months	Extrapolated Nitrogen Concentration, mg/L
0	45.4
12	29.5
24	19.7
36	10.2
48	4.5
60	2.7
72	3.1
84	2.0
96	1.6
108	1.1
120	0.6

TECHNICAL MEMORANDUM

July 30, 2010

To: Emily Corsi, Montana Environmental Policy Act Specialist

From: Lisa M. Boettcher, Reclamation Specialist
Catherine Dreesbach, P.E. Mining Engineer

Re: Stillwater Mining Company (SMC) Projected Off-Shaft Discharge Projection and Nitrogen Loading Estimates for Post-Closure

This memo describes the agencies' analysis to estimate post-closure nitrogen loading to the Stillwater River from the flooding of workings below the 5,000-foot elevation at the Stillwater Mine. This analysis parallels and reviews SMC's analysis (Hydrometrics 2004). Included in this memo are updated end-of-mining volume and backfill projections based on the long-range mine plan provided to the agencies by SMC (SMC 2009).

Calculations for Mined-Out Void

The agencies used the former mine plan provided by SMC to calculate the volumes of backfill and voids in production and development workings at the Stillwater Mine through December 2008 (Table 1). These calculations update the volumes used in the 2004 Hydrometrics technical memorandum. SMC has updated its long-term mine plan and provided data to the agencies so that calculations could be made for 2009 to the end of mining (Table 2). The 2009 to the end of mining void and backfill volumes are used to project post-closure nitrogen loading from water filling the workings below the 5,000-foot level.

Ground Water Hydraulics

The rate of ground water inflow to the Stillwater Mine workings currently averages about 640 to 650 gallons per minute (gpm). The upper workings are above 5,000 feet and would not flood post-mining because the regional water table is below this elevation. The off-shaft is a vertical shaft that extends 1,900 feet beneath the Stillwater River Valley floor through the lower workings. It is used to dewater the lower workings (those below 5,000 feet) (Figure 1, Hydrometrics 2004, attached).

After the underground is decommissioned at closure, the east-side and west-side portals would be plugged with permeable waste rock plugs, and pumping of ground water from the lower workings would cease. Snowmelt and precipitation that infiltrates above the upper workings would flow vertically through open and backfilled areas and fractures to fill the lower workings of the mine. The rate of inflow from the upper workings is estimated to average about 280 gpm at closure (Hydrometrics 2004). This inflow rate is expected to continue post-closure. Surrounding ground water would flow laterally into the deeper workings of the mine. Eventually the level of water in the flooding workings would rise to the 4,972-foot elevation of the off-shaft collar then discharge. Because its elevation is lowest, water would discharge from the off-shaft collar before discharging from the 4,974-foot east portal or the 5,000-foot west portal (Figure 2, Hydrometrics 2004, attached).

The off-shaft has been grouted to prevent water infiltration from the alluvial gravels of the Stillwater River (4,900-foot elevation). Although the alluvial gravels are at a lower elevation than the collar of the off-shaft, while the grout remains competent, off-shaft water would not discharge to the Stillwater River alluvium. In the event, however, that water would directly discharge to the alluvium, the loading calculations in this memo remain valid.

The hydrostatic pressure of ground water is dynamic and primarily dependent upon its elevation. The rate of water inflow to the workings and off-shaft would not be dependent on the total volume of workings, but would depend on the elevation of rising water. As the workings flood the hydrostatic pressure increases. Initially the rate of flooding is rapid, and as the workings fill, the flooding rate slows. Using the updated end-of-mining backfill and void volumes, SMC estimated that if the mine reaches its full projected extent, it would take between four and 48 years to fill the workings, depending on ground water inflow rate (SMC 2009).

The agencies assume that there will be no discharge of water from the lower workings until the flooded elevation reaches the collar of the off-shaft. The agencies have confirmed SMC's ground water flow calculations (Hydrometrics 2004), and concur that when the workings are nearly flooded the rate of inflow to the off-shaft is expected to be 20 to 40 gpm. The water entering the off-shaft from the lower workings would mix with the projected 280 gpm of inflow from the upper workings and approximately 300 to 320 gpm would discharge from the off-shaft post-closure. The agencies used the higher 40 gpm inflow rate from the workings and 320 gpm off-shaft discharge rate for this analysis.

Nitrogen Loading

In the 2004 technical memorandum, Hydrometrics estimated the potential contribution of nitrogen from tailings, waste rock, and paste backfill materials based on column leach tests performed by SMC in 1988 and 2003 (Hydrometrics 2004). Hydrometrics constructed a mass balance mixing model to estimate the potential nitrogen concentration and load in mine waters that would discharge from the off-shaft. Hydrometrics projected flows, and performed surface water mixing calculations and sensitivity analyses to evaluate the influence of individual parameters on the modeling results. This enabled Hydrometrics to assess a maximum nitrogen loading scenario. The agencies have reviewed Hydrometrics' calculations for verification purposes. No measurements of leached salts were taken from the three types of backfill materials. Salts will not be addressed further in this memo.

In this analysis, the agencies assume that the nitrogen concentration in mine water flowing from the upper workings would decrease over time as indicated by the Projected Nitrogen Concentration Decline Curve (DEQ 2010). The agencies agree that water moving through the flooded lower workings would flush nitrogen compounds from the mine. The highest concentration of nitrogen would occur in the first pore volume of mine water from the workings. The nitrogen concentration would decrease in subsequent pore volumes of water flowing from the flooded workings. It is not known how long it would take for one complete pore volume of ground water to flow through the workings, but is likely to be on the order of decades.

The agencies independently calculated the nitrogen concentration of water discharging from the off-shaft using the pore volume concentrations estimated by SMC (Hydrometrics 2004). The agencies calculated the nitrogen loads for the first and second pore volumes of water flowing through the workings. The first pore volume of mine water would contain the maximum nitrogen concentration, and provides a conservative (worst-case) loading scenario.

Calculations for Nitrogen Loading at Closure

The nitrogen loading calculations that follow are based on the volume of void, volume of backfill, and type of backfill. The ground water inflow rate affects the time to flood the mine.

Concentration of the First Pore Volume

The projected nitrogen concentrations of the first pore volume of water that flood the workings are as follows (Hydrometrics 2004):

30 mg/L	N_{T1}	from tailings backfilled areas
30 mg/L	N_{CP1}	from cemented paste backfilled areas
112 mg/L	N_{WR1}	from waste rock backfilled areas
0.2 mg/L	N_V	from void (empty) areas, upper east- and west-side workings

where V_P is the pore volume of backfilled areas (Tailings, Cemented Paste, Waste Rock), and V_{Void} is the volume of the void (empty) areas, calculated by the agencies from data provided by SMC (Table 1).

Calculation for Nitrogen Concentration in Water from Flooded Workings (through 2008):

These calculations project the nitrogen concentration and load that would be expected from the flooded workings if closure at the Stillwater Mine was imminent.

$$= \frac{(V_{P\ Tailings} \times N_{T1} + V_{P\ Cemented\ Paste} \times N_{P1} + V_{P\ Waste\ Rock} \times N_{WR1} + V_{Void\ Workings} \times N_V)}{(V_{P\ Tailings} + V_{P\ Cemented\ Paste} + V_{P\ Waste\ Rock} + V_{Void\ Workings})}$$

= 33.9 mg/L nitrogen (first pore volume)

Calculation for Nitrogen Concentration in Water Discharged from Off-Shaft (through 2008):

where V is volumetric flow rate and C is concentration:

$$= \frac{(V_{east\text{-}side\ workings} \times C_{east\text{-}side} + V_{west\text{-}side\ workings} \times C_{west\text{-}side} + V_{flooded\ workings} \times C_{flooded\ workings})}{(V_{east\text{-}side\ workings} + V_{west\text{-}side\ workings} + V_{flooded\ workings})}$$

$$= \frac{(160\ gpm \times 0.2\ mg/L + 120\ gpm \times 0.2\ mg/L + 40\ gpm \times 33.9\ mg/L)}{(160\ gpm + 120\ gpm + 40\ gpm)}$$

= 4.4 mg/L nitrogen (first pore volume)

Nitrogen Load$_{1stPV\ 2008}$ = (320 gpm x 4.4 mg/L x 0.012 lbs min L $mg^{-1}gal^{-1}day^{-1}$) = 16.9 lbs/day

The total nitrogen load of 16.9 lbs/day exiting from the off-shaft is less than the 100 lbs/day MPDES permit load for the Stillwater Mine. A nitrogen load less than 100 lbs/day would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

- To check the sensitivity of this calculation, the agencies recalculated using a nitrogen concentration of 10 mg/L for the 280 gpm from the upper workings and flooded mine voids. The weighted average nitrogen concentration in the flooded workings water would then be 40 mg/L. The weighted average concentration of nitrogen in water discharged from the off-shaft is 13.7 mg/L, and the nitrogen load is 52.8 lbs/day. This load is less than the 100 lbs/day MPDES permit load for the Stillwater Mine and would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

Calculation for Nitrogen Concentration in Water from Flooded Workings at End-of Mining:

The calculation for the first pore volume nitrogen concentration of flooded workings was repeated using the updated end-of-mining void and backfill volumes. These calculations project the nitrogen concentration and load that would be expected from the flooded workings at full build-out at the end of mining. These volumes were calculated by the agencies from data provided by SMC (Table 2).

$$= \frac{(V_{P\ Tailings} \times N_{T1} + V_{P\ Cemented\ Paste} \times N_{P1} + V_{P\ Waste\ Rock} \times N_{WR1} + V_{Void\ Workings} \times N_V)}{(V_{P\ Tailings} + V_{P\ Cemented\ Paste} + V_{P\ Waste\ Rock} + V_{Void\ Workings})}$$

= 31.2 mg/L nitrogen (first pore volume)

Calculation for Nitrogen Concentration in Water Discharged from Off-Shaft at End-of Mining:

$$= \frac{(V_{east\text{-}side\ workings} \times C_{east\text{-}side} + V_{west\text{-}side\ workings} \times C_{west\text{-}side} + V_{flooded\ workings} \times C_{flooded\ workings})}{(V_{east\text{-}side\ workings} + V_{west\text{-}side\ workings} + V_{flooded\ workings})}$$

$$= \frac{(160\ \text{gpm} \times 0.2\ \text{mg/L} + 120\ \text{gpm} \times 0.2\ \text{mg/L} + 40\ \text{gpm} \times 31.2\ \text{mg/L})}{(160\ \text{gpm} + 120\ \text{gpm} + 40\ \text{gpm})}$$

= 4.1 mg/L (first pore volume)

Nitrogen Load$_{1stPV\ E\text{-}o\text{-}M}$ = (320 gpm x 4.1 mg/L x 0.012 lbs min L $mg^{-1}gal^{-1}day^{-1}$) = 15.7 lbs/day

The total nitrogen load of 15.7 lbs/day is less than the 100 lbs/day MPDES permit load for the Stillwater Mine. A nitrogen load less than 100 lbs/day would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

- To check the sensitivity of this calculation, the agencies recalculated using a nitrogen concentration of 10 mg/L for the 280 gpm from the upper workings and flooded mine voids. The weighted average nitrogen concentration in the flooded workings water would then be 37.5 mg/L. The weighted average concentration of nitrogen in water discharged from the off-shaft is 13.4 mg/L, and the nitrogen load is 51.6 lbs/day. This load is less than the 100 lbs/day MPDES permit load for the Stillwater Mine. A nitrogen load less than 100 lbs/day would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

Concentration of the Second Pore Volume

The projected nitrogen concentrations of the second pore volume of water that floods the workings are as follows (Hydrometrics 2004):

0.4 mg/L N_{T2} from tailings backfilled areas
0.4 mg/L N_{CP2} from cemented paste backfilled areas
29 mg/L N_{WR2} from waste rock backfilled areas
0.2 mg/L N_V from void (empty) areas

where V_P is the pore volume of backfilled areas (Tailings, Cemented Paste, Waste Rock), and V_{Void} is the volume of the void (empty) areas, calculated by the agencies from data provided by SMC (Table 1).

Calculation for Nitrogen Concentration in Water from Flooded Workings (through 2008):

$$= \frac{(V_{P\ Tailings} \times N_{T2} + V_{P\ Cemented\ Paste} \times N_{P2} + V_{P\ Waste\ Rock} \times N_{WR2} + V_{Void\ Workings} \times N_V)}{(V_{P\ Tailings} + V_{P\ Cemented\ Paste} + V_{P\ Waste\ Rock} + V_{Void\ Workings})}$$

= 8.1 mg/L nitrogen concentration (second pore volume)

Calculation for Nitrogen Concentration in Water Discharged from Off-Shaft (through 2008):
where V is volumetric flow rate and C is concentration:

$$= \frac{(V_{\text{east-side workings}} \times C_{\text{east-side}} + V_{\text{west-side workings}} \times C_{\text{west-side}} + V_{\text{flooded workings}} \times C_{\text{flooded workings}})}{(V_{\text{east-side workings}} + V_{\text{west-side workings}} + V_{\text{flooded workings}})}$$

$$= \frac{(160 \text{ gpm} \times 0.2 \text{ mg/L} + 120 \text{ gpm} \times 0.2 \text{ mg/L} + 40 \text{ gpm} \times 8.1 \text{ mg/L})}{(160 \text{ gpm} + 120 \text{ gpm} + 40 \text{ gpm})}$$

= 1.2 mg/L nitrogen (second pore volume)

Nitrogen Load$_{2ndPV\ 2008}$ = (320 gpm x 1.2 mg/L x 0.012 lbs min L $mg^{-1}gal^{-1}day^{-1}$) = 4.5 lbs/day

The total nitrogen load is 4.5 lbs/day, which is less than the 100 lbs/day MPDES permit load for the Stillwater Mine. A nitrogen load less than 100 lbs/day would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

Calculation for Nitrogen Concentration in Water from Flooded Workings at End-of Mining:
The calculation for the second pore volume nitrogen concentration of flooded workings was repeated using the updated end-of-mining void and backfill volumes. These calculations project the nitrogen concentration and load that would be expected from the flooded workings at full build-out at the end of mining. These volumes were calculated by the agencies from data provided by SMC (Table 2).

$$= \frac{(V_{\text{P Tailings}} \times N_{T1} + V_{\text{P Cemented Paste}} \times N_{P1} + V_{\text{P Waste Rock}} \times N_{WR1} + V_{\text{Void Workings}} \times N_V)}{(V_{\text{P Tailings}} + V_{\text{P Cemented Paste}} + V_{\text{P Waste Rock}} + V_{\text{Void Workings}})}$$

= 7.3 mg/L nitrogen (second pore volume)

Calculation for Nitrogen Concentration in Water Discharged from Off-Shaft at End-of Mining:

$$= \frac{(V_{\text{east-side workings}} \times C_{\text{east-side}} + V_{\text{west-side workings}} \times C_{\text{west-side}} + V_{\text{flooded workings}} \times C_{\text{flooded workings}})}{(V_{\text{east-side workings}} + V_{\text{west-side workings}} + V_{\text{flooded workings}})}$$

$$= \frac{(160 \text{ gpm} \times 0.2 \text{ mg/L} + 120 \text{ gpm} \times 0.2 \text{ mg/L} + 40 \text{ gpm} \times 31.2 \text{ mg/L})}{(160 \text{ gpm} + 120 \text{ gpm} + 40 \text{ gpm})}$$

= 1.1 mg/L (second pore volume)

Nitrogen Load$_{2ndPV\ E\text{-}o\text{-}M}$ = (320 gpm x 1.1 mg/L x 0.012 lbs min L $mg^{-1}gal^{-1}day^{-1}$) = 4.5 lbs/day

The total nitrogen load of 4.5 lbs/day is less than the 100 lbs/day MPDES permit load for the Stillwater Mine. A nitrogen load less than 100 lbs/day would result in a nitrogen concentration less than 1 mg/L in the Stillwater River.

<u>*Conclusions*</u>
This memo provides the basis of the agencies' estimate of post-closure nitrogen loading to the Stillwater River from the flooding of Stillwater Mine workings. This analysis parallels and reviews SMC's analysis (Hydrometrics 2004) and includes updated end-of-mining backfill and

void projections based on the long-range mine plan provided to the agencies by SMC (SMC 2009).

The highest concentration of nitrogen would occur in the first pore volume of mine water entering the off-shaft, and is a conservative (worst-case) loading scenario. The nitrogen concentration would decrease in subsequent pore volumes of water flowing through the flooded workings. No estimates have been made of the time it would take for one pore volume of ground water to flow through the workings, but is likely to be on the order of decades.

The nitrogen load in the first pore volume of water that would discharge post-closure from the off-shaft would be about 17 lbs/day, which is less than the MPDES permit limit of 100 lbs/day. Based upon these calculations, the MPDES permit limit for nitrogen would be met and no treatment of off-shaft water would be necessary post-closure.

References

DEQ. Stillwater Mining Company Projected Nitrogen Concentration Decline Curve. Technical Memorandum. July 2010. 14 pages.

Freeze R. A. and J. A. Cherry. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, NJ. 1979. 604 pages.

Hydrometrics. Projected Off-Shaft Discharge Projection and Nitrogen Loading Estimates after Closure. Technical Memorandum. September 2004. 8 pages + Attachment 6 pages.

SMC. Off-Shaft Filling Projection – Update. Technical Memorandum. February 2009. 1 page.

Table 1. ***Volumes Below the 5,000-foot Level Through December 2008***

	Void Volume, ft^3
2008 Development and Production	**128,000,000**
2008 Volume of Open Workings	**45,176,480**
Empty Production Void	31,064,012
Development Void	14,112,459
2008 Sum of Backfilled Volumes	**82,823,520**

Backfill Material	Mass, tons	2008 Backfill Volume, ft^3	Drainable Porosity, percent	2008 Backfill Pore Volume, ft^3
Tailings	828,235	16,564,700	40	6,625,880
Cement Paste	828,235	16,564,700	8	1,325,176
Waste Rock	2,484,706	49,694,120	40	19,877,648

Table 2. ***Volumes Below the 5,000-foot Level from January 2009 to End of Mining***

	Void Volume, ft^3
Life-of-Mine Void Volume	**259,919,118**
2009 Volume of Open Workings	**45,176,480**
2009 Empty Production Void	31,064,012
2009 Development Void	14,112,459
End of Mining Empty Production Void	**160,167,123**
End of Mining Development Void	**54,575,524**

Backfill Material	Mass, tons	Backfill Volume, ft^3	Drainable Porosity, percent	Backfill Pore Volume, ft^3	Life-of Mine Backfill Pore Volume, ft^3
Tailings	3,202,941	64,058,820	40	32,249,408	38,875,288
Cement Paste	3,202,941	64,058,820	8	6,449,882	7,775,058
Waste Rock	7,606,985	152,139,700	40	80,733,528	100,611,176

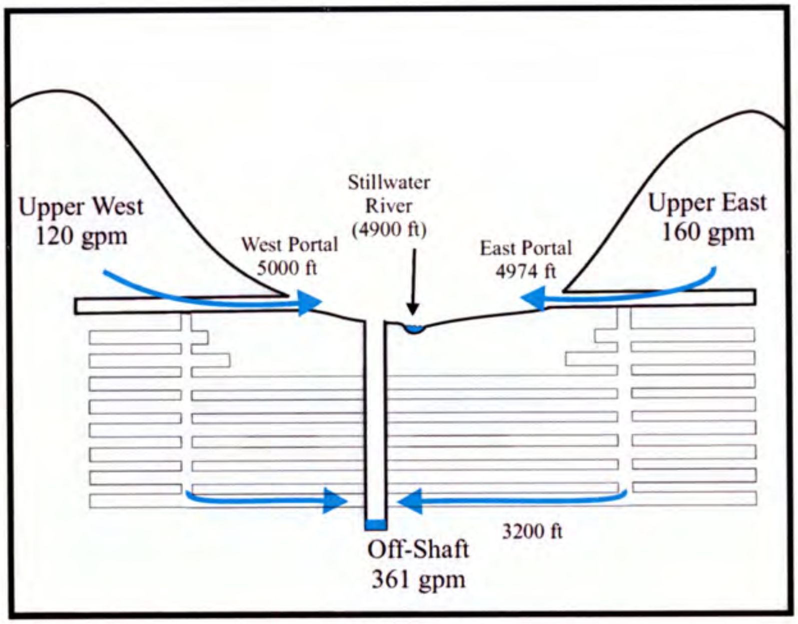

Figure 1.
Flow Schematic
Present Operational Scenario

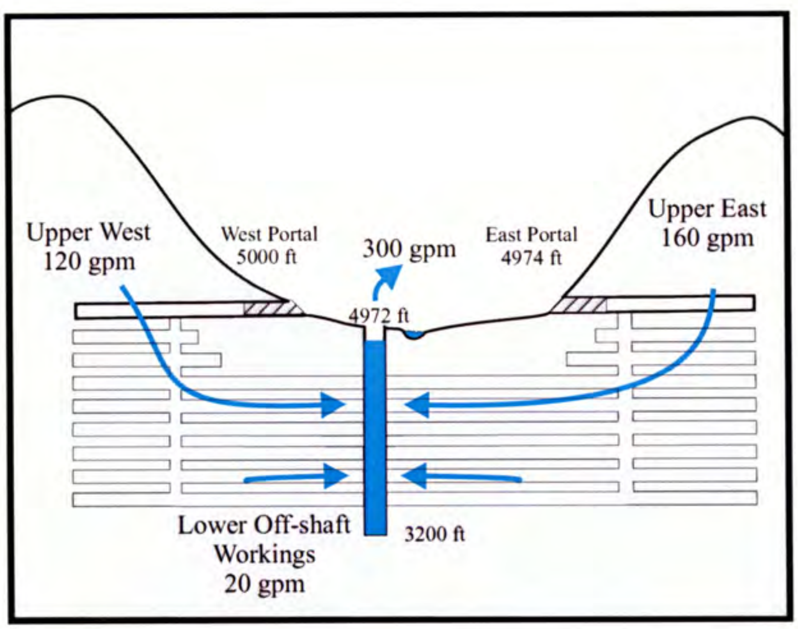

Figure 2.
Flow Schematic
Closure Scenario

K:\project\Nload Schematic2.cdr

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Stillwater 2,020 gpm CLOSURE scenarios		**No Action Alternative 1A**	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A

No Action Alternative 1A Option 1, 2,020 gpm: *Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm (24 hr) untreated east side adit water would be at the Stillwater Mine east side percolation ponds. Disposal of 1,770 gpm (24 hr) treated west side adit water and 100 MG Hertzler Ranch LAD storage pond treated adit water would be at the Hertzler Ranch LAD area. The closure time frame was not specified.*

NOTE: This option exceeds the hydraulic load at Hertzler Ranch LAD.

No Action Alternative 1A Option 2, 2,020 gpm : *Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm (24 hr) untreated east side water and 1,770 gpm (24 hr) of treated west side adit water would be at the Stillwater Mine percolation ponds. Disposal of 100 MG of Hertzler Ranch LAD storage pond treated adit water would be at the Hertzler Ranch LAD area. The closure time frame was not specified.*

Stillwater Mine	criteria			
TN load to Stillwater River at Stillwater Mine, lbs/day	100	62		
Total closure TN load to ground water, days 1-365, lbs/12-mo		22,630		
TN concentration in ground water below Stillwater Mine, mg/L	10	meets MPDES TN load		
TN concentration in Stillwater River below Stillwater Mine, mg/L	1	meets MPDES TN load		
EC in ground water at Stillwater Mine, µmhos/cm	1,000	364		
TDS in Stillwater River below Stillwater Mine, mg/L	250	98		
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10	1.3		
Total closure TN load to ground water at Hertzler Ranch LAD, lbs/12-mo		1,963		
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1	0.5		
EC in ground water at Hertzler Ranch LAD, µmhos/cm	1,000	574		
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250	96		

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Stillwater 2,020 gpm CLOSURE scenarios		No Action Alternative 1A	**Proposed Action Alternative 2A**	Agency-Mitigated Alternative 3A

Proposed Action Alternative 2A, Option 1, 2,020 gpm: *The 250 gpm (24 hr) of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds. Up to 250 gpm (24 hr) Stillwater Tailings waters would be mixed and treated with 1,770 gpm (24 hr) west side adit water and routed to Hertzler Ranch LAD storage pond for disposal with 521 gpm (12 hr) untreated Hertzler Ranch tailings waters. The closure time frame would be 12 months.*

NOTE: This option exceeds the hydraulic load at Hertzler Ranch LAD.

Proposed Action Alternative 2A Option 2, 2,020 gpm: The *250 gpm (24 hr) of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds. Up to 250 gpm (24 hr) Stillwater tailings waters would be mixed and treated with 1,770 gpm (24 hr) west side adit water and routed to the Stillwater Mine percolation ponds. Up to 45 MG of untreated Hertzler Ranch tailings waters would be routed to the Hertzler Ranch LAD storage pond containing 100 MG of treated adit water for disposal at the Hertzler Ranch LAD area. The closure time frame would be 12 months.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100		92	
Total closure TN load to ground water, days 1-365, lbs/12-mo			33,580	
TN concentration in ground water below Stillwater Mine, mg/L	10		meets MPDES TIN load	
TN concentration in Stillwater River below Stillwater Mine, mg/L	1		meets MPDES TIN load	
EC in ground water at Stillwater Mine, µmhos/cm	1,000		664	
TDS in Stillwater River below Stillwater Mine, mg/L	250		119	
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10		1.2	
Total closure TN load to ground water at Hertzler Ranch LAD, lbs/12-mo			11,835	
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1		0.4	
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000		752	
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250		105	

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Stillwater 2,020 gpm CLOSURE scenarios		No Action Alternative 1A	Proposed Action Alternative 2A	**Agency-Mitigated Alternative 3A**

Agency-Mitigated Alternative 3A Option 1, 2,020 gpm: Stillwater Mine first season*: The 250 gpm (24 hr) of untreated east side adit water would be disposed in the Stillwater Mine percolation ponds days 1-90, then routed underground on day 91. The 250 gpm (24 hr) of Stillwater tailings waters would be mixed and treated with 1,770 gpm (24 hr) of west side adit water and routed to the Stillwater Mine percolation ponds days 1-97, then routed underground on day 98 after the Stillwater tailings impoundment is dewatered.*

Hertzler Ranch first season*: Up to 260 gpm (24 hr) of the untreated 45 MG Hertzler Ranch tailings waters would be routed to the 100 MG of treated adit waters in Hertzler Ranch LAD storage pond, and the mixed adit and tailings waters would be disposed at the Hertzler Ranch LAD area. Hertzler Ranch second season: Any excess water that cannot be disposed the first year would be land applied at Hertzler Ranch. The closure time frame would be 18 months.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100			92
Total closure TN load to ground water, days 1-548, lbs/18-mo				8,917
TN concentration in ground water below Stillwater Mine, mg/L	10			meets MPDES TN load
TN concentration in Stillwater River below Stillwater Mine, mg/L	1			meets MPDES TN load
EC in ground water at Stillwater Mine, µmhos/cm	1,000			664
TDS in Stillwater River below Stillwater Mine, mg/L	250			119
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10			1.6
Total closure TN load to ground water at Hertzler Ranch LAD, lbs/18-mo				11,835
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1			0.5
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000			752
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250			105

NOTE: Under this scenario a temporary exceedance of the 1,000 µmhos/cm Beneficial Use EC criterion for ground water would occur in the vicinity of the assumed Hertzler Ranch tailings impoundment seep and beneath the upper LAD area but the Beneficial Use criterion would be met at the down-gradient compliance point, HMW-10.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Stillwater 650 gpm CLOSURE scenarios		**No Action Alternative 1A**	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
***No Action Alternative 1A Option 1, 650 gpm**: The tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm (24 hr) untreated east side adit water would be at the Stillwater Mine east side percolation ponds. Disposal of 400 gpm (24 hr) treated west side adit water and 100 MG of treated west side adit water stored in the Hertzler Ranch LAD storage pond waters would be at the Hertzler Ranch LAD area. The closure time frame was not specified.*				
Stillwater Mine	criteria			
TN load to Stillwater River at Stillwater Mine, lbs/day	100	12		
Total closure TN load to ground water, days 1-365, lbs/12-mo		4,380		
TN concentration in ground water below Stillwater Mine, mg/L	10	meets MPDES TIN load		
TN concentration in Stillwater River below Stillwater Mine, mg/L	1	meets MPDES TIN load		
EC in ground water at Stillwater Mine, µmhos/cm	1,000	174		
TDS in Stillwater River below Stillwater Mine, mg/L	250	51		
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10	1.3		
Total closure TN load to ground water at Hertzler Ranch LAD, lbs/12-mo		8,688		
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1	0.5		
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000	574		
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250	96		

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Stillwater 650 gpm CLOSURE scenarios		No Action Alternative 1A	**Proposed Action Alternative 2A**	Agency-Mitigated Alternative 3A
Proposed Action Alternative 2A Option 1, 650 gpm: *The 250 gpm (24 hr) of untreated east side adit water would be disposed in the Stillwater Mine percolation ponds. The 400 gpm (24 hr) west side adit water would be mixed and treated with 600 gpm (24 hr) Stillwater tailings waters and routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water and 40 MG of Hertzler Ranch tailings waters. All these waters would be disposed at the Hertzler Ranch LAD area. The time frame for disposal is 12 months.*				
Stillwater Mine	criteria			
TN load to Stillwater River at Stillwater Mine, lbs/day	100		12	
Total closure TN load to ground water, days 1-365, lbs/12-mo			4,380	
TN concentration in ground water below Stillwater Mine, mg/L	10		meets MPDES TIN load	
TN concentration in Stillwater River below Stillwater Mine, mg/L	1		meets MPDES TIN load	
EC in ground water at Stillwater Mine, µmhos/cm	1,000		174	
TDS in Stillwater River below Stillwater Mine, mg/L	250		51	
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10		1.1	
Total closure TN load to ground water at Hertzler Ranch LAD, lbs/12-mo			22,902	
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1		0.4	
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000		904	
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250		126	

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Stillwater 650 gpm CLOSURE scenarios		No Action Alternative 1A	**Proposed Action Alternative 2A**	Agency-Mitigated Alternative 3A
Proposed Action Alternative 2A Option 2, 650 gpm: *The 250 gpm (24 hr) of untreated east side adit water would be disposed in the Stillwater Mine percolation ponds. The 400 gpm (24 hr) west side adit water would be mixed and treated with 600 gpm (24 hr) Stillwater tailings waters and 716 gpm (24 hr) of that flow would be routed to the Stillwater Mine percolation ponds for disposal. The other 284 gpm (24 hr) would be routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water with up to 45 MG of Hertzler Ranch tailings waters. The time frame for disposal is 12 months.*				
Stillwater Mine	criteria			
TN load to Stillwater River at Stillwater Mine, lbs/day	100		99	
Total closure TN load to ground water, days 1-365, lbs/12-mo			36,135	
TN concentration in ground water below Stillwater Mine, mg/L	10		meets MPDES TIN load	
TN concentration in Stillwater River below Stillwater Mine, mg/L	1		meets MPDES TIN load	
EC in ground water at Stillwater Mine, µmhos/cm	1,000		661	
TDS in Stillwater River below Stillwater Mine, mg/L	250		89	
Hertzler Ranch LAD				
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10		1.1	
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1		0.4	
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000		926	
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250		128	

NOTE: The EC of ground water at the Stillwater Mine temporarily exceeds the 1,000 µmhos Class I Beneficial Use criterion at the end of the east side percolation ponds just prior to entering the mixing zone for the Stillwater Valley Ranch percolation ponds, but meets the criterion prior to discharge to the Stillwater River. The EC of ground water at Hertzler Ranch temporarily exceeds the 1,000 µmhos/cm Beneficial Use EC criterion for ground water in the vicinity of the assumed Hertzler Ranch tailings impoundment seep and beneath the upper LAD area but the Beneficial Use criterion would be met at the down-gradient compliance point, HMW-10.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Stillwater 650 gpm CLOSURE scenarios		No Action Alternative 1A	Proposed Action Alternative 2A	**Agency-Mitigated Alternative 3A**

Agency-Mitigated Alternative 3A Option 1, 650 gpm: Stillwater Mine first season *The 250 gpm (24 hr) untreated east side adit water would be disposed at east side percolation ponds days 1-90. From day 91 on, all untreated east side and west side adit water would be routed to the underground workings. Days 1-41, the 400 gpm (24 hr) west side adit water would be mixed and treated with 600 gpm (24 hr) Stillwater tailings waters and routed to Hertzler Ranch LAD storage pond. From day 42 on, the Stillwater tailings impoundment would be dewatered and treated west side adit waters would be routed to the Hertzler Ranch LAD storage pond.*

Hertzler Ranch first LAD season days 1-41: *The mixed and treated 400 gpm (24 hr) of west side adit water and 600 gpm Stillwater tailings waters would be routed to the Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. Days 42-90 up to 396 gpm (24 hr) of untreated Hertzler Ranch tailings waters would be routed to the Hertzler Ranch LAD storage pond and disposed at the Hertzler Ranch LAD area.*

Hertzler Ranch second LAD season*: any excess water that could not be disposed the first year due to high precipitation, unforeseen circumstances where Stillwater would be unable to fulfill its obligations, etc. would be land applied at Hertzler Ranch. The time frame would be up to 18 months.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100			12
Total closure TN load to ground water, days 1-548, lbs/18-mo				6,082
TN concentration in ground water below Stillwater Mine, mg/L	10			meets MPDES TIN load
TN concentration in Stillwater River below Stillwater Mine, mg/L	1			meets MPDES TIN load
EC in ground water at Stillwater Mine, µmhos/cm	1,000			174
TDS in Stillwater River below Stillwater Mine, mg/L	250			51
Hertzler Ranch LAD				
Total closure TN load to ground water, days 1-548, lbs/18-mo				22,960
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10			1.3 to 3.6
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1			0.5 to 0.8
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000			691 to **1,057**
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250			117 to **322**

NOTE: A temporary exceedance of the 1,000 µmhos/cm beneficial use EC criterion for ground water would occur in the vicinity of the assumed Hertzler Ranch tailings impoundment seep. If the entire load were disposed in one 120-day LAD season, a temporary exceedance of the 1,000 µmhos/cm beneficial use EC criterion for ground water would occur in the vicinity of HMW-10. If the entire load were disposed in one 120-day LAD season, the total nitrogen concentrations in ground water would exceed the 2 mg/L above background trigger limit for the Hertzler Ranch LAD.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Stillwater 650 gpm CLOSURE scenarios		No Action Alternative 1A	Proposed Action Alternative 2A	**Agency-Mitigated Alternative 3A**

Agency-Mitigated Alternative 3A Option 2, 650 gpm: Stillwater Mine first season *The 250 gpm (24 hr) untreated east side adit water would be disposed at east side percolation ponds days 1-90. From day 91 on, all untreated east side and west side adit water would be routed to the underground workings. Days 1-41, the 400 gpm (24 hr) west side adit water would be mixed and treated with 600 gpm (24 hr) Stillwater tailings waters; 716 gpm (24 hr) routed to east-side percolation ponds, 284 gpm (24 hr) routed to Hertzler Ranch LAD storage pond. From days 42-120, the Stillwater tailings impoundment would be dewatered and 400 gpm (24 hr) treated west side adit waters would be routed to the Hertzler Ranch LAD storage pond for LAD. On day 121, all west-side adit water would be routed underground to flood workings.*

Hertzler Ranch first LAD season days 1-41: *284 gpm (24 hr) of the mixed and treated 400 gpm (24 hr) of west side adit water and 600 gpm Stillwater tailings waters would be routed to the Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. Days 42-90 up to 396 gpm (24 hr) of untreated Hertzler Ranch tailings waters would be routed to the Hertzler Ranch LAD storage pond and disposed at the Hertzler Ranch LAD area.*

Hertzler Ranch second LAD season*: any excess water that could not be disposed the first year due to high precipitation, unforeseen circumstances where Stillwater would be unable to fulfill its obligations, etc. would be land applied at Hertzler Ranch. The time frame would be up to 18 months.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100			99
Total closure TN load to ground water, days 1-548, lbs/18-mos				9,621
TN concentration in ground water below Stillwater Mine, mg/L	10			meets MPDES TIN load
TN concentration in Stillwater River below Stillwater Mine, mg/L	1			meets MPDES TIN load
EC in ground water at Stillwater Mine, µmhos/cm	1,000			270 to 477
TDS in Stillwater River below Stillwater Mine, mg/L	250			58
Hertzler Ranch LAD				
Total closure TN load to ground water, days 1-548, lbs/18-mos				19,580
TN concentration in ground water below Hertzler Ranch LAD, mg/L	10			1.3 to 2.5
TN concentration in Stillwater River below Hertzler Ranch LAD, mg/L	1			0.5 to 0.6
EC in ground water below Hertzler Ranch LAD, µmhos/cm	1,000			679 to 947
TDS in Stillwater River below Hertzler Ranch LAD, mg/L	250			105 to 129

NOTE: A temporary exceedance of the 1,000 µmhos/cm beneficial use EC criterion for ground water would occur in the vicinity of the assumed Hertzler Ranch tailings impoundment seep.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Stillwater 2,020 gpm **POST-CLOSURE scenarios**		**No Action** **Alternative 1A**	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A

Post-Closure No Action Alternative 1A Option 1, 2,020 gpm Percolation: *West side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 25.3 mg/L TN and 378 mg/L TDS based on the nitrogen decline curve and Stillwater data. The east side adit water quality is anticipated to be 0.01 mg/L TN and 155 mg/L TDS based on the nitrogen decline curve and Stillwater data. This analysis assumes all adit water is percolated to the Stillwater Mine percolation ponds.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100	**537**		
TN concentration in ground water at the Stillwater Mine, mg/L	10	**14**		
TN concentration in the Stillwater River at Stillwater Mine, mg/L	1	**2.9**		
TDS in Stillwater River below Stillwater Mine, mg/L	250	76		
EC in ground water at Stillwater Mine, µmhos/cm	1,000	333		

NOTE: If 2,020 gpm (24 hr) untreated adit water were percolated at the Stillwater Mine, the concentration of TN in the Stillwater River would exceed the 1 mg/L set by the MPDES permit. This exceedance would be temporary and occur during post-closure period until the west side adit water quality reduced to 8 mg/L. Based upon the nitrogen decline curve this is anticipated to take about 8 months after closure. At 22 months after closure, the discharge would meet the 100 lbs/day MPDES limit.

Post-Closure No Action Alternative 1A Option 2, 2,020 gpm Direct Discharge: *West Side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 25.3 mg/L TIN and 378 mg/L TDS based on the decline curves. The east side adit water quality is anticipated to be 0.1 mg/L TIN and 155 mg/L TDS based on the decline curves. This analysis assumes all adit water is directly discharged to the Stillwater River at the Stillwater Mine.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100	**537**		
TN concentration in the Stillwater River at Stillwater Mine, mg/L	1	**3.1**		
TDS in Stillwater River below Stillwater Mine, mg/L	250	84		

NOTE: If 2,020 gpm (24 hr) untreated adit water were directly discharged to the Stillwater River at the Stillwater Mine, the concentration of TN in the Stillwater River would exceed the 1 mg/L set by the MPDES permit. This exceedance would be temporary and occur during post-closure period until the west side adit water quality reduced to 6.5 mg/L. Based upon the nitrogen decline curve this is anticipated to take about 48 months after closure. At 58 months after closure, the discharge would meet the 100 lbs/day MPDES limit.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Stillwater 650 gpm **POST-CLOSURE scenarios**		**No Action** **Alternative 1A**	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A

Post-Closure No Action Alternative 1A Option 1, 650 gpm Percolation: *West Side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 25.3 mg/L TIN and 378 mg/L TDS. The east side adit water quality is anticipated to be 0.01 mg/L TIN and 155 mg/L TDS. This analysis assumes all adit water is percolated into the Stillwater Mine percolation ponds.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100	**121**		
TN concentration in ground water at the Stillwater Mine, mg/L	10	5.7		
TN concentration in the Stillwater River at Stillwater Mine, mg/L	1	0.9		
TDS in Stillwater River below Stillwater Mine, mg/L	250	58		
EC in ground water at Stillwater Mine, µmhos/cm	1,000	247		

NOTE: A temporary exceedance of the TN load to the Stillwater River at the Stillwater Mine would occur during post-closure until the west side adit water quality reduced to 20 mg/L. This is anticipated to take less than 1 month. Although the discharge initially exceeds the 100 lbs/day MPDES TN limit, the concentrations in ground and surface water meet applicable criteria.

Post-Closure No Action Alternative 1A Option 2, 650 gpm Direct Discharge: *West Side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 21 mg/L TIN and 378 mg/L TDS based on the decline curves. The east side adit water quality is anticipated to be 0.01 mg/L TIN and 155 mg/L TDS based on the decline curves. This analysis assumes all adit water is directly discharged to the Stillwater River at the Stillwater Mine.*

Stillwater Mine	criteria	No Action Alternative 1A	Proposed Action Alternative 2A	Agency-Mitigated Alternative 3A
TN load to Stillwater River at Stillwater Mine, lbs/day	100	**121**		
TN concentration in the Stillwater River at Stillwater Mine, mg/L	1	1		
TDS in Stillwater River below Stillwater Mine, mg/L	250	56		

NOTE: A temporary exceedance of the TN load to the Stillwater River at the Stillwater Mine would occur during post-closure until the west side adit water quality reduced to 20 mg/L. This is anticipated to take less than 1 month. Although the discharge initially exceeds the 100 lbs/day MPDES TN limit, the concentrations in ground and surface water meet applicable criteria.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 737 gpm CLOSURE scenarios	criteria	**No Action Alternative 1B**	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B

No Action Alternative 1B Option 1, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes that LAD areas 2, 3-Upper, and 4 have been built to manage water at East Boulder Mine. East Boulder tailings waters are evaporated over the tailings mass; 737 gpm (24 hr) treated adit water is land applied at LAD areas 2, 3-Upper, 4, and 6 at East Boulder Mine. The closure period for this alternative is not specified, but for the purposes of analysis, was assumed to occur in 12 months.*

NOTE: The hydraulic load of 737 gpm (24 hr) would exceed the capacity of the 0.7 MG storage pond and the disposal capability of the East Boulder Mine LAD areas 2, 3-Upper, 4 and 6. Additional water management measures would be necessary in both summer and winter.

No Action Alternative 1B Option 2, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes that LAD areas 2, 3-Upper, and 4 have been built to manage water at East Boulder Mine. East Boulder tailings waters are evaporated over the tailings mass; 737 gpm (24 hr) treated adit water is land applied at LAD areas 2, 3-Upper, 4, and 6 at East Boulder Mine, and the excess waters are percolated. Summer and winter disposal scenarios were evaluated separately. Summer scenario: 725 gpm treated adit water would be land applied at LAD areas 2, 3-Upper, 4, and 6, and 12 gpm (24 hr) treated adit water would be percolated. Winter scenario: 285 gpm treated adit water would be disposed using snowmaking at LAD areas 3-Upper, 4, and 6, and 452 gpm (24 hr) treated adit water would be percolated. The closure period for this alternative is not specified, but for the purposes of analysis, all disposal of water was assumed to occur in 12 months.*

	criteria	No Action Alternative 1B	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B
Closure commences in summer using LAD				
TIN load at East Boulder Mine, lbs/day summer	30	10		
Total closure TIN load to ground water, days 1-365, lbs/12-mos		1,180		
TIN concentration in ground water at East Boulder Mine, mg/L summer	10	0.5		
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1	0.2		
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000	877		
TDS in East Boulder River at East Boulder Mine, mg/L summer	250	179		
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30	13.8		
Total closure TIN load to ground water, days 1-365, lbs/12-mo		1,658		
TIN concentration in ground water at East Boulder Mine, mg/L winter	10	1.0		
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1	0.4		
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000	718		
TDS in East Boulder River at East Boulder Mine, mg/L winter	250	171		

NOTE: For both winter and summer closure scenarios: An extended length of time would be needed to evaporate the tailings waters over the tailings mass.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 737 gpm CLOSURE scenarios		No Action Alternative 1B	**Proposed Action Alternative 2B**	Agency-Mitigated Alternative 3B
Proposed Action Alternative 2B Option 1, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes up to 737 gpm (24 hr) adit water and 263 gpm (24 hr) East Boulder tailings waters would be treated in the BTS/Anox system for nitrogen then preferentially disposed at the mine percolation pond. The time frame for closure is 12 months. Days 1-120, treated adit plus tailings waters would be percolated. Days 121-365, treated adit water would be percolated.*				
East Boulder Mine	criteria			
TIN load at East Boulder Mine, lbs/day	30		**51.6**	
EC in ground water at East Boulder Mine, µmhos/cm	1,000		630 to 750	
TDS in East Boulder River at East Boulder Mine, mg/L	250		178 to 225	

NOTE: Percolation of 737 gpm (24 hr) treated adit and 263 gpm (24 hr) treated tailings waters using percolation exceeds the MPDES permit 30 lbs/day TIN limit. Additional nitrogen treatment methods must be used such as LAD.

Proposed Action Alternative 2B Option 2, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes up to 737 gpm (24 hr) adit and 263 gpm (24 hr) are disposed at the mine LAD areas. This analysis assumes that all East Boulder LAD areas 2, 3-Upper, 4, and 6, are constructed and operating to manage the adit water. Summer and winter disposal scenarios were evaluated separately. The time frame for closure would be 12 months.*

NOTE: For a closure scenario that commences in either summer or winter, there is insufficient hydraulic capacity at the East Boulder Mine LAD areas to manage the hydraulic load of 737 gpm (24 hr) treated adit and 263 gpm (24 hr) treated tailings waters. Additional water disposal methods must be used such as LAD.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 737 gpm CLOSURE scenarios		No Action Alternative 1B	**Proposed Action Alternative 2B**	Agency-Mitigated Alternative 3B
Proposed Action Alternative 2B Option 3, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes up to 737 gpm (24 hr) adit and 263 gpm (24 hr) are disposed maximizing the East Boulder Mine LAD areas with contingency disposal at the percolation pond. This analysis assumes that all East Boulder LAD areas 2, 3-Upper, 4, and 6, are constructed and operating to manage the adit water. Summer and winter disposal scenarios were evaluated separately. The time frame for closure would be 12 months.*				
Closure commences in summer using LAD	criteria			
TIN load at East Boulder Mine, lbs/day summer	30		20.9	
Total closure TIN load to ground water days 1-365, lbs				
TIN concentration in ground water at East Boulder Mine, mg/L summer	10		2	
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1		0.9	
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000		591 to 834	
TDS in East Boulder River at East Boulder Mine, mg/L summer	250		169 to 246	
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30		**37.7**	
TIN concentration in ground water at East Boulder Mine, mg/L winter	10		2.4	
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1		1.0	
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000		591 to 759	
TDS in East Boulder River at East Boulder Mine, mg/L winter	250		169 to 217	

NOTE: The total inorganic nitrogen load produced from the winter disposal of 737 gpm (24 hr) treated adit water and 263 gpm (24 hr) treated tailings waters maximizing LAD disposal at the East Boulder Mine LAD areas exceeds the MPDES permitted 30 lbs/day limit at the mine.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 737 gpm CLOSURE scenarios		No Action Alternative 1B	Proposed Action Alternative 2B	**Agency-Mitigated Alternative 3B**

Agency-Mitigated Alternative 3B Option 1, 737 gpm: *The Boe Ranch LAD system and the East Boulder LAD areas 2, 3-Upper, and 4 are not built. The 737 gpm of treated adit waters plus 83 gpm treated tailings waters would be disposed in the East Boulder Mine percolation pond as in Proposed Action Alternative 2B, but over an 18-month closure time frame.*

East Boulder Mine	criteria	No Action Alternative 1B	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B
TIN load at East Boulder Mine, lbs/day	30			30
Total closure TIN load to ground water, days 1-548, lbs/18-mo				12,495
EC in ground water at East Boulder Mine, µmhos/cm	1,000			640
TDS in East Boulder River at East Boulder Mine, mg/L	250			185

Agency-Mitigated Alternative 3B Option 2, 737 gpm: *The Boe Ranch LAD system is not built. All approved mine LAD areas would be constructed. The 737 gpm (24 hr) adit and 83 gpm (24 hr) treated East Boulder tailings waters would be preferentially disposed at the East Boulder LAD areas 2, 3-Upper, and 4. Summer and winter closure scenarios are evaluated separately. The closure time frame would be 18 months.*

NOTE: The hydraulic load of 737 gpm adit water plus 83 gpm tailings waters exceeds the capacity of the approved East Boulder Mine LAD areas in summer and winter and cannot be managed solely by land application at the East Boulder Mine. Some excess water would need to be percolated.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 737 gpm CLOSURE scenarios		No Action Alternative 1B	Proposed Action Alternative 2B	**Agency-Mitigated Alternative 3B**

Agency-Mitigated Alternative 3B Option 3, 737 gpm: *The Boe Ranch LAD system is not built. All approved mine LAD areas would be constructed. The 737 gpm (24 hr) adit and 83 gpm (24 hr) treated East Boulder tailings waters would be preferentially disposed at the East Boulder LAD areas 2, 3-Upper, and 4, and excess waters would be discharged to the East Boulder Mine percolation pond. Days 1-120, treated adit plus tailings waters would be LAD and the excess water percolated. Days 121-335, treated adit plus tailings waters would be percolated. Days 336-548, treated adit water would be percolated. Summer and winter closure scenarios are evaluated separately. The closure time frame would be 18 months.*

Closure commences in summer using LAD	criteria	No Action Alternative 1B	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B
TIN load at East Boulder Mine, lbs/day summer	30			8.8 to 22.3
Total closure TIN load to ground water, days 1-548, lbs/18-mos				11,118
TIN concentration in ground water at East Boulder Mine, mg/L summer	10			0.7 to 1.8
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1			0.4 to 0.8
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000			619 to 761
TDS in East Boulder River at East Boulder Mine, mg/L summer	250			175 to 197
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30			19.5 to 23.5
Total closure TIN load to ground water, days 1-548, lbs/18-mos				13,047
TIN concentration in ground water at East Boulder Mine, mg/L winter	10			1.4 to 1.8
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1			0.6 to 0.8
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000			618 to 678
TDS in East Boulder River at East Boulder Mine, mg/L winter	250			167 to 179

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 150 gpm CLOSURE scenarios		**No Action Alternative 1B**	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B
No Action Alternative 1B Option 1, 150 gpm: *The Boe Ranch LAD system is not built; East Boulder Mine LAD areas 2, 3-Upper, 4 are not built; East Boulder tailings waters are evaporated over the tailings mass; 150 gpm (24 hr) treated adit water is land applied at LAD Area 6 at East Boulder Mine. Summer and winter disposal scenarios were evaluated separately.*				
Closure commences in summer using LAD	criteria			
TIN load at East Boulder Mine, lbs/day summer	30	4 to 20		
Total summer closure TIN load to ground water, days 1-365, lbs/12-mo		7,786		
TIN concentration in ground water at East Boulder Mine, mg/L summer	10	0.9		
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1	0.3		
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000	506		
TDS in East Boulder River at East Boulder Mine, mg/L summer	250	115		
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30	4 to 20		
Total summer closure TIN load to ground water, days 1-365, lbs/12-mo		9,425		
TIN concentration in ground water at East Boulder Mine, mg/L winter	10	0.9		
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1	0.3		
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000	506		
TDS in East Boulder River at East Boulder Mine, mg/L winter	250	115		

East Boulder 150 gpm CLOSURE scenarios		No Action Alternative 1B	**Proposed Action Alternative 2B**	Agency-Mitigated Alternative 3B
Proposed Action Alternative 2B Option 2, 150 gpm: *The Boe Ranch LAD system is not constructed. This analysis assumes up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) would be percolated at East Boulder Mine percolation pond. The time frame for closure would be 12 months.*				
TIN load at East Boulder Mine, lbs/day	30		**47.8**	
EC in ground water at East Boulder Mine, µmhos/cm	1,000		354 to 644	
TDS in East Boulder River at East Boulder Mine, mg/L	250		93 to 148	

NOTE: Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the East Boulder Mine percolation pond would exceed the MPDES 30 lbs/day total inorganic nitrogen limit. Additional nitrogen treatment methods would need to be employed such as LAD.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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East Boulder 150 gpm CLOSURE scenarios	No Action Alternative 1B	**Proposed Action Alternative 2B**	Agency-Mitigated Alternative 3B

Proposed Action Alternative 2B Option 2, 150 gpm: *The Boe Ranch LAD system and the East Boulder Mine LAD areas 2, 3-Upper, 4 are not constructed. Up to 150 gpm (24 hr) treated adit water and 232 gpm (24 hr) treated East Boulder tailings waters would be disposed at LAD Area 6 at East Boulder Mine. Summer and winter disposal scenarios were evaluated separately. The time frame for closure would be 12 months.*

NOTE: For a closure scenario that commences in either summer or winter, there is insufficient hydraulic capacity at the East Boulder Mine LAD Area 6 to manage the hydraulic load of 150 gpm (24 hr) treated adit and 263 gpm (24 hr) treated tailings waters. Additional water disposal methods must be used such as percolation.

East Boulder 150 gpm CLOSURE scenarios		No Action Alternative 1B	**Proposed Action Alternative 2B**	Agency-Mitigated Alternative 3B

Proposed Action Alternative 2B Option 3, 150 gpm: *The Boe Ranch LAD system and the East Boulder Mine LAD areas 2, 3-Upper, 4 are not constructed. Up to 150 gpm (24 hr) treated adit water and 232 gpm (24 hr) treated East Boulder tailings waters would be disposed at LAD Area 6 at East Boulder Mine, with the disposal of excess waters at the mine percolation pond. Summer and winter disposal scenarios were evaluated separately. The time frame for closure would be 12 months.*

	criteria	No Action Alternative 1B	Proposed Action Alternative 2B	Agency-Mitigated Alternative 3B
Closure commences in summer using LAD				
TIN load at East Boulder Mine, lbs/day summer	30		18.5 to 20.0	
Total summer closure TIN load to ground water, days 1-365, lbs/12-mo			7,118	
TIN concentration in ground water at East Boulder Mine, mg/L summer	10		2.1	
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1		0.7	
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000		365 to 883	
TDS in East Boulder River at East Boulder Mine, mg/L summer	250		92 to 222	
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30		20 to 27.3	
Total winter closure TIN load to ground water, days 1-365, lbs/12-mo			8,176	
TIN concentration in ground water at East Boulder Mine, mg/L winter	10		2.9	
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1		0.9	
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000		365 to 843	
TDS in East Boulder River at East Boulder Mine, mg/L winter	250		92 to 219	

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

East Boulder 150 gpm CLOSURE scenarios		No Action Alternative 1B	Proposed Action Alternative 2B	**Agency-Mitigated Alternative 3B**
Agency-Mitigated Alternative 3B Option 1, 150 gpm: *The Boe Ranch and LAD areas 2, 3-Upper, 4 are not built. This analysis assumes up to 150 gpm treated adit water plus 83 gpm treated tailings waters would be disposed at the East Boulder Mine percolation pond. The closure time frame would be 18 months.*				
TIN load at East Boulder Mine, lbs/day	30			20 to 30
Total closure TIN load to ground water, days 1-548, lbs/18-mo				14,293
EC in ground water at East Boulder Mine, µmhos/cm	1,000			365 to 475
TDS in East Boulder River at East Boulder Mine, mg/L	250			92 to 115
Agency-Mitigated Alternative 3B Option 2, 150 gpm: *The Boe Ranch and LAD areas 2, 3-Upper, 4 are not built. This analysis assumes up to150 gpm treated adit water plus 83 gpm treated tailings waters would be disposed at the East Boulder Mine LAD Area 6. No percolation would be used. The closure time frame would be 18 months.*				
NOTE: There is insufficient hydraulic capacity at the East Boulder Mine LAD Area 6 to manage the hydraulic load of 150 gpm (24 hr) treated adit and 83 gpm (24 hr) treated tailings waters. Additional water disposal methods must be used such as percolation.				
Agency-Mitigated Alternative 3B Option 3, 150 gpm: *The Boe Ranch and LAD areas 2, 3-Upper, 4 are not built. This analysis assumes up to150 gpm treated adit water plus 83 gpm treated tailings waters would be preferentially disposed at the East Boulder Mine LAD Area 6, with excess waters disposed at the mine percolation pond. Closure commencing in summer and winter were evaluated separately. The closure time frame would be 18 months.*				
Closure commences in summer using LAD	criteria			
TIN load at East Boulder Mine, lbs/day summer	30			7.5 to 30
Total summer closure TIN load to ground water, days 1-548				11,606
TIN concentration in ground water at East Boulder Mine, mg/L summer	10			0.9 to 2.9
TIN concentration in East Boulder River at East Boulder Mine, mg/L summer	1			0.4 to 0.8
EC in ground water at East Boulder Mine, µmhos/cm summer	1,000			307 to 577
TDS in East Boulder River at East Boulder Mine, mg/L summer	250			81 to 129
Closure commences in winter using snowmaking				
TIN load at East Boulder Mine, lbs/day winter	30			8.9 to 30
Total winter closure TIN load to ground water, lbs/18 mos				11,766
TIN concentration in ground water at East Boulder Mine, mg/L winter	10			1.1 to 2.9
TIN concentration in East Boulder River at East Boulder Mine, mg/L winter	1			0.4 to 1.0
EC in ground water at East Boulder Mine, µmhos/cm winter	1,000			304 to 516
TDS in East Boulder River at East Boulder Mine, mg/L winter	250			80 to 117

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Boe Ranch 737 gpm OPERATIONS scenarios	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

No Action Alternative 1C OPERATIONS, 737 gpm: *the Boe Ranch LAD system is not constructed. There would be no effect from LAD at the Boe Ranch.*

Boe Ranch 737 gpm OPERATIONS scenarios	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

Proposed Action Alternative 2C OPERATIONS Option 1, 737 gpm: *Preferential disposal of all 737 gpm (24 hr) adit water would occur at the Boe Ranch LAD at agronomic rates with contingency disposal of treated adit water at the East Boulder Mine percolation pond.*

NOTE: During the 120 day LAD season, the hydraulic load of 737 gpm (24 hr) adit water can be managed at Boe Ranch LAD if all 10 pivots are operating at agronomic rates as proposed by SMC. However, the LAD storage pond would fill the first 95 days of winter and excess adit waters would have to managed at the East Boulder Mine percolation ponds and by winter snowmaking. During the following LAD season, the hydraulic load of 737 gpm (24 hr) could be managed at Boe Ranch LAD, but no capacity would exist to dewater the LAD storage pond.

Boe Ranch 737 gpm OPERATIONS scenarios	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

Proposed Action Alternative 2C OPERATIONS Option 2, 737 gpm: *During the LAD season days 1-120, up to 164 gpm (24 hr) treated adit water plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates, and 573 gpm (24 hr) is disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 283 gpm (24 hr) treated adit water can be routed to the Boe Ranch LAD storage pond and up to 454 gpm (24 hr) would be disposed at the East Boulder Mine percolation pond.*

LAD season days 1-120 East Boulder Mine	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
TIN load East Boulder Mine, lbs/day	30		15.5	
TIN concentration in ground water below East Boulder Mine, mg/L	10		meets MPDES TIN load	
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1		meets MPDES TIN load	
EC in ground water below East Boulder Mine, µmhos/cm	1,000		474	
TDS in East Boulder River below East Boulder Mine, mg/L	250		143	
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L	10		0.5	
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1		0.3	
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1		0.2	
EC in ground water below Boe Ranch, µmhos/cm	2,500		1,041	
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250		**452**	
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250		**371**	

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 737 gpm OPERATIONS scenarios		No Action Alternative 1C	**Proposed Action Alternative 2C**	Agency-Mitigated Alternative 3C
Proposed Action Alternative 2C OPERATIONS Option 2, 737 gpm, continued: *for the description of this option, please see the previous page.* ***days 121-365 East Boulder Mine***				
TIN load East Boulder Mine, lbs/day	30		12.3	
TIN concentration in ground water East Boulder Mine, mg/L	10		meets MPDES TIN load	
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1		meets MPDES TIN load	
EC in ground water below East Boulder Mine, µmhos/cm winter	1,000		435	
TDS in East Boulder River below East Boulder Mine, mg/L winter	250		137	

NOTE: The ambient East Boulder River TDS concentration of 340 gm/L at EBR-008 is greater than the recommended 250 mg/L TDS concentration for the protection of trout eggs. Land application disposal of 743 gpm (24 hr) of treated mixed waters would increase the TDS concentration by 9 to 33 percent at EBR-008, depending upon the East Boulder River flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Boe Ranch 737 gpm OPERATIONS scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**

Agency-Mitigated Alternative 3C OPERATIONS Option 1, 737 gpm: *To operationally address the hydraulic volume of 737 gpm adit water and dewater the Boe Ranch LAD storage pond annually, only 284 gpm (24 hr) treated adit water with 579 gpm (24 hr) Boe Ranch LAD stored waters could be land applied at Boe Ranch LAD with 7 pivots operating on 166 acres at greater than agronomic rates as is done at Hertzler Ranch LAD. The remaining 453 gpm (24 hr) adit water must be managed seasonally at the East Boulder Mine LAD areas (293 gpm 24 hr summer rate, 205 gpm 24 hr winter rate) and percolation pond (160 gpm 24-hr summer rate, 248 gpm 24-hr winter rate).*

East Boulder Mine	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
TIN load East Boulder Mine, lbs/day	30			5.9 to 12.3
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine (LAD or snowmaking), µmhos/cm	1,000			478 to 527
TDS in East Boulder River below East Boulder Mine (LAD or snowmaking), mg/L	250			129 to 132
EC in ground water below East Boulder Mine percolation off-season, µmhos/cm	1,000			508
TDS in East Boulder River below East Boulder Mine percolation off-season, mg/L	250			100
Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			1.6
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.8
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.5
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			1,023
TDS in East Boulder River below Boe Ranch, mg/L	250			**426 to 493**

NOTE: The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. Land application disposal of 1,726 gpm (12 hr) treated adit and Boe Ranch LAD storage pond waters at the Boe Ranch LAD area would increase the TDS concentration from 25 to 45 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Boe Ranch 150 gpm OPERATIONS scenarios		**No Action Alternative 1C**	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

No Action Alternative 1C, 150 gpm: *the Boe Ranch LAD system is not constructed. There would be no effect from LAD at the Boe Ranch.*

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 150 gpm OPERATIONS scenarios	No Action Alternative 1C	**Proposed Action Alternative 2C**	Agency-Mitigated Alternative 3C

Proposed Action Alternative 2C OPERATIONS Option 2, 150 gpm: *During the LAD season days 1-120, up to 150 gpm (24 hr) treated adit water plus 301 gpm (24 hr) stored pond water would be applied at Boe Ranch LAD at agronomic rates. No water would be disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 150 gpm (24 hr) treated adit water would be routed to the Boe Ranch LAD storage pond. The capacity of the Boe Ranch LAD storage pond would be adequate to store eight months of treated adit water (52 MG).*

	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
days 1-120 East Boulder Mine		no disposal at the East Boulder Mine days 1-120	
LAD season days 1-120 Boe Ranch LAD			
TIN concentration in ground water below Boe Ranch, mg/L	10	1.7	
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1	0.9	
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1	0.5	
EC in ground water below Boe Ranch, µmhos/cm	2,500	1,017	
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250	**458**	
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250	**377**	
Days 121-365 Boe Ranch LAD		adit water stored in Boe Ranch LAD storage pond; no disposal occurs	

NOTE: The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. Land application disposal of 902 gpm (12 hr) Boe Ranch LAD storage pond waters would increase the ambient TDS concentration at EBR-008 from 11 to 35 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 150 gpm OPERATIONS scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**
Agency-Mitigated Alternative 3C OPERATIONS Option 1, 150 gpm: *During the LAD season days 1-120, up to 150 gpm (24 hr) treated adit water plus 301 gpm (24 hr) stored pond water would be applied at Boe Ranch LAD at greater than agronomic rates. No water would be disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 150 gpm (24 hr) treated adit water would be routed to the Boe Ranch LAD storage pond. The capacity of the Boe Ranch LAD storage pond would be adequate to store eight months of treated adit water (52 MG).*				
days 1-365 East Boulder Mine LAD season days 1-120 Boe Ranch LAD				no disposal at the East Boulder Mine
TIN concentration in ground water below Boe Ranch, mg/L summer	10			2.3
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			**1.2**
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.7
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			989
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**485**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**422**
days 121-365 water storage occurs at the Boe Ranch				no disposal at the Boe Ranch LAD days 121-365

NOTE: The projected concentration of nitrogen in the East Boulder River would be greater than 1 mg/L total inorganic nitrogen when the East Boulder River flow rate is less than 2 cfs. If the flow in the East Boulder River is 3 cfs, the projected concentration of nitrogen would equal 1 mg/L total inorganic nitrogen. The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. Land application disposal of 902 gpm (12 hr) Boe Ranch LAD storage pond waters would increase the TDS concentration in the East Boulder River from 24 to 43 percent, depending upon flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water could be disposed at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 737 gpm CLOSURE scenarios	**No Action Alternative 1C**	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

No Action Alternative 1C Option 1, 737 gpm: *The Boe Ranch LAD system is not built and this analysis assumes that LAD areas 2, 3-Upper, and 4 have been built to manage water at the East Boulder Mine. The East Boulder tailings waters are evaporated over the tailings mass. The 737 gpm (24 hr) treated adit water is land applied at LAD areas 2, 3-Upper, 4, and 6 at East Boulder Mine. Summer and winter disposal scenarios were evaluated separately. The results of this analysis are equivalent to the No Action Alternative 1B, Option 1, 737 gpm. No time frame was given for closure.*

Boe Ranch 737 gpm CLOSURE scenarios	No Action Alternative 1C	**Proposed Action Alternative 2C**	Agency-Mitigated Alternative 3C

Proposed Action Alternative 2C Option 1, 737 gpm: *The Boe Ranch LAD system is built. The East Boulder tailings impoundment would be dewatered at 263 gpm (24 hr) and treated with 737 gpm (24 hr) adit water through the BTS/Anox system. Based on the hydraulic load calculations, only 743 gpm (24 hr) can be disposed at the Boe Ranch LAD. During the LAD season, days 1-120, up to 164 gpm (24 hr) of treated adit and tailings waters plus 579 gpm (24 hr) stored pond water would be applied at the Boe Ranch LAD at agronomic rates. The remaining 833 gpm (24 hr) would be disposed at the East Boulder Mine (293 gpm would be routed to LAD Area 6, and 540 gpm would be routed to the percolation pond.) For the remainder of closure (days 121-365), 737 gpm (24 hr) treated adit water would be disposed at the East Boulder Mine percolation pond. The time frame for closure would be 12 months.*

days 1-120 East Boulder Mine	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
TIN load East Boulder Mine, lbs/day	30		29.9	
TIN concentration in ground water below East Boulder Mine, mg/L	10		meets MPDES TIN load	
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1		meets MPDES TIN load	
EC in ground water below East Boulder Mine, µmhos/cm	1,000		645	
TDS in East Boulder River below East Boulder Mine, mg/L	250		192	
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10		0.5	
Total winter closure TIN load to ground water, lbs/12-mos			4,597	
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1		0.3	
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1		0.2	
LAD season days 1-120 Boe Ranch LAD, continued				
EC in ground water below Boe Ranch, µmhos/cm summer	2,500		1,017	
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250		**444**	
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250		**366**	

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 737 gpm CLOSURE scenarios		No Action Alternative 1C	**Proposed Action Alternative 2C**	Agency-Mitigated Alternative 3C
Proposed Action Alternative 2C, Option 1 737 gpm, continued. *For a description of this option, please see the previous page.*				
days 121-365 East Boulder Mine				
TIN load East Boulder Mine, lbs/day	30		20	
Total winter closure TIN load to ground water, lbs/12-mo			8,488	
TIN concentration in ground water below East Boulder Mine, mg/L	10		meets MPDES TIN load	
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1		meets MPDES TIN load	
EC in ground water below East Boulder Mine, µmhos/cm	1,000		511	
TDS in East Boulder River below East Boulder Mine, mg/L	250		157	

NOTE: The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs in the East Boulder River. The ambient concentration at EBR-008 would be increased from 8 to 31 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Boe Ranch 737 gpm CLOSURE scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**

Agency-Mitigated Alternative 3C, Option 1, 737 gpm: *At closure, SMC would treat 737 gpm adit water and 263 gpm tailings waters in the BTS. The closure time frame would be 18 months.* ***Days 1-120:*** *SMC would maximize disposal of 284 gpm treated adit and tailings waters with 579 gpm (24 hr) stored waters at the Boe Ranch LAD area at greater than agronomic rates. SMC would dispose of the remaining 716 gpm at the East Boulder Mine. LAD Area 6 would receive 293 gpm and the excess 423 gpm would be routed to the East Boulder Mine percolation pond during the first 120 day summer LAD season in the 18-month closure period.*

Days 121-365: *After day 120, the tailings impoundment would be closed and only 737 gpm of treated adit water would need disposal during the rest of the 18-month closure period. From days 121-365, up to 284 gpm would be routed to the Boe Ranch LAD storage pond, and 453 gpm would be disposed at the East Boulder Mine percolation pond.*

Days 366-548: *During the second year 120 day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters in the Boe Ranch LAD storage pond. After the second year LAD season, all 737 gpm of treated adit water would be disposed at the East Boulder Mine percolation pond.*

days 1-120 East Boulder Mine	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
TIN load East Boulder Mine, lbs/day	30			24.8
Total TIN load to ground water at East Boulder Mine during closure, lbs/18 mos				8,719
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			798
TDS in East Boulder River below East Boulder Mine, mg/L	250			210
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			0.9
Total TIN load to ground water at Boe Ranch LAD during closure, days 1-486				1,630
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.4
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.3
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			1,035
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**497**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**429**
days 121-365 East Boulder Mine				
TIN load East Boulder Mine, lbs/day	30			12.3
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			828
TDS in East Boulder River below East Boulder Mine, mg/L	250			238

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

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Summary of Projected Water Quality by Alternative

Boe Ranch 737 gpm **CLOSURE scenarios**		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated** **Alternative 3C**
Agency-Mitigated Alternative 3C, Option 1, 737 gpm, continued. *For the description of this option, please see the previous page.*				
Second year LAD season days 366-486 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			0.5
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.3
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.2
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			786
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**419**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**385**
TIN load East Boulder Mine, lbs/day	30			12.3 to 20
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			535 to 669
TDS in East Boulder River below East Boulder Mine, mg/L	250			157 to 207

NOTE: The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. The ambient concentration of TDS at EBR-008 would be increased from 26 to 46 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Boe Ranch 150 gpm **CLOSURE scenarios**	**No Action** **Alternative 1C**	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C

No Action Alternative 1C Option 1, 150 gpm: *The Boe Ranch LAD system is not built and this analysis assumes that East Boulder Mine LAD areas 2, 3-Upper, and 4 have not been built at the East Boulder Mine. The East Boulder tailings waters are evaporated over the tailings mass. The 150 gpm (24 hr) treated adit water is land applied at LAD Area 6 at East Boulder Mine. Summer and winter disposal scenarios were evaluated separately. The results of this analysis are equivalent to the No Action Alternative 1B, Option 1, 150 gpm. No time frame was given for closure.*

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Boe Ranch 150 gpm CLOSURE scenarios		No Action Alternative 1C	**Proposed Action Alternative 2C**	Agency-Mitigated Alternative 3C
Proposed Action Alternative 2C Option 1, 150 gpm: *Days 1-120 Up to 150 gpm (24 hr) adit water would be mixed and treated with 286 gpm tailings waters and routed to the Boe Ranch LAD storage pond. The 436 gpm (24 hr) mixed, treated adit and tailings waters would mix with 52 MG of treated stored water in the LAD storage pond, then land applied at Boe Ranch LAD at agronomic rates 743 gpm (24 hr rate). Days 121-365: During the rest of the 12-month closure period, the 150 gpm (24 hr) would be routed to the East Boulder Mine percolation pond.*				
days 1-120 East Boulder Mine			no disposal at the East Boulder Mine	
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10		2.0	
Total TIN load to ground water at Boe Ranch LAD during closure, days 1-120			11,372	
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1		**1.2**	
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1		0.8	
EC in ground water below Boe Ranch, µmhos/cm summer	2,500		1,164	
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250		**488**	
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250		**390**	
days 121-365 East Boulder Mine				
TIN load East Boulder Mine, lbs/day	30		20	
Total TIN load to ground water at Boe Ranch LAD during closure, days 121-365			4,900	
TIN concentration in ground water below East Boulder Mine, mg/L	10		meets MPDES TIN load	
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1		meets MPDES TIN load	
EC in ground water below East Boulder Mine, µmhos/cm	1,000		358	
TDS in East Boulder River below East Boulder Mine, mg/L	250		97	

NOTE: The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. The ambient concentration of TDS would be increased from 15 to 44 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of Boe Ranch.

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Boe Ranch 150 gpm CLOSURE scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**

Agency-Mitigated Alternative 3C, Option 1, 150 gpm: *SMC would treat 436 gpm (150 gpm adit water and 286 gpm of tailings waters) at closure to reserve hydraulic capacity to empty the East Boulder Mine tailings impoundment in the first 120-day LAD season. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would maximize treated adit and tailings waters disposal (436 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond) at the Boe Ranch LAD area at greater than agronomic rates. After the 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. Water would be disposed at the East Boulder Mine days 487 to 548 of the 18-month closure period.*

	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
days 1-120 East Boulder Mine				no disposal at the East Boulder Mine
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			1.8
Total TIN load to ground water at Boe Ranch LAD during closure, days 1-486				5,092
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.8
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.4
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			1,177
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**530**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**445**
days 121-365 East Boulder Mine				no disposal at the East Boulder Mine
Second year LAD season days 366-486 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			2.1
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.8
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.5
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			596
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**351**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**345**

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Boe Ranch 150 gpm CLOSURE scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**
Agency-Mitigated Alternative 3C, Option 1, 150 gpm, continued. *For the description of this option, please see the previous page.*				
days 366-548 East Boulder Mine				
TIN load East Boulder Mine, lbs/day	30			20
Total TIN load to ground water at East Boulder Mine during closure, days 487-548				1,240
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			762
TDS in East Boulder River below East Boulder Mine, mg/L	250			198

NOTE: The total inorganic nitrogen concentration in the East Boulder River below the diversion point would exceed 1.0 mg/L if the streamflow was less than 3.0 cfs. The ambient median TDS concentration of 340 mg/L at EBR-008 is greater than the recommended 250 mg/L concentration for the protection of trout eggs. The ambient concentration of TDS would be increased from 31 to 56 percent, depending on flow rate. Given the ambient TDS concentration of the East Boulder River and the TDS concentration in adit water, no volume of adit water can be land applied at a rate that would reduce the concentration in the East Boulder River downstream of Boe Ranch.

Agency-Mitigated Alternative 3C, Option 2, 150 gpm: SMC would treat 436 gpm (150 gpm adit water and 286 gpm of tailings waters) at closure to empty the East Boulder Mine tailings impoundment in 79 days. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. SMC would percolate 200 gpm at the East Boulder Mine to reduce the nitrogen load to the East Boulder River at the Boe Ranch. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would dispose of 236 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond at the Boe Ranch LAD area at greater than agronomic rates. After the first 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. The 150 gpm of treated adit water would be disposed at the East Boulder Mine days 487 to 548 of the 18-month closure period.

days 1-120 East Boulder Mine	criteria	No Action Alternative 1C	Proposed Action Alternative 2C	Agency-Mitigated Alternative 3C
TIN load East Boulder Mine, lbs/day	30			25
Total TIN load to ground water at East Boulder Mine during closure, days 487-548				
TIN concentration in ground water below East Boulder Mine, mg/L	10			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			687
TDS in East Boulder River below East Boulder Mine, mg/L	250			148

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

Appendix C DEQ 2010
Summary of Projected Water Quality by Alternative

Boe Ranch 150 gpm CLOSURE scenarios		No Action Alternative 1C	Proposed Action Alternative 2C	**Agency-Mitigated Alternative 3C**
Agency-Mitigated Alternative 3C, Option 2, 150 gpm, continued. *For the description of this option, please see the previous page.*				
LAD season days 1-120 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			1.8
Total TIN load to ground water at Boe Ranch LAD during closure, days 1-486				3,035
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.8
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.4
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			1,041
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**468**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**407**
days 121-365 East Boulder Mine				no disposal at the East Boulder Mine
Second year LAD season days 366-486 Boe Ranch LAD				
TIN concentration in ground water below Boe Ranch, mg/L summer	10			2.1
TIN concentration in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	1			0.7
TIN concentration in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	1			0.4
EC in ground water below Boe Ranch, µmhos/cm summer	2,500			584
TDS in East Boulder River below Boe Ranch, mg/L (2.0 cfs flow)	250			**349**
TDS in East Boulder River below Boe Ranch, mg/L (5.0 cfs flow)	250			**344**
days 366-548 East Boulder Mine				
TIN load East Boulder Mine, lbs/day	10			20
Total TIN load to ground water at East Boulder Mine during closure, days 1-548				4,245
TIN concentration in ground water below East Boulder Mine, mg/L	1			meets MPDES TIN load
TIN concentration in East Boulder River below East Boulder Mine, mg/L	1			meets MPDES TIN load
EC in ground water below East Boulder Mine, µmhos/cm	1,000			286
TDS in East Boulder River below East Boulder Mine, mg/L	250			124

Note: The concentrations listed above are projected values based on best available data.
TIN Total Inorganic Nitrogen; TN Total Nitrogen (Stillwater Mine only); EC Electrical Conductivity;
TDS Total Dissolved Solids; MG Million gallons

2010 Stillwater Mine Water Management Plan EIS Spreadsheets

2010 Stillwater Mine Water Management Plan EIS Spreadsheet Formatting Key

The electronic Excel spreadsheets contain the formulas used to make the calculations for this environmental analysis, and every effort has been made to minimize error. For a summary of these results, please see the Summary of Water Quality by Alternative Table, also found in Appendix C. This key will make the most sense if used by the reader while reviewing a printed or electronic spreadsheet.

- ***Title:*** The initial line shown in orange is the title of the spreadsheet. The spreadsheets are named by alternative and labeled "Nitrogen Calculations" for the analysis of total inorganic nitrogen or "Salts Calculations" for the analysis of salts. Two spreadsheets have been constructed for each alternative. All spreadsheets contain analyses of what the agencies considered reasonable, non-prescriptive options for the management of water at closure, and if applicable to the alternative, operations or post-closure. Several options are listed on a given spreadsheet. Headers assist the reader in tracking which option is being evaluated.

- ***Assumptions made:*** Beneath the orange title box is a yellow box with blue text that describes the assumptions for the calculations made in that spreadsheet. The overarching assumptions are consistent for each constituent (nitrogen or salts) and location (Stillwater Mine and Hertzler Ranch LAD system, East Boulder Mine, and Boe Ranch LAD System), regardless of the alternative.

- ***Options analyzed:*** The green boxes indicate which option has been analyzed for the calculations that follow. For some of the analyses, several options were evaluated. The options analyzed were not intended to be prescriptive, but are reasonable representations of the alternative; often, there are multiple options possible for each alternative. The options analyzed provide a reasonable estimate of projected water quality and quantity impacts for the alternative, if chosen and implemented. In all options, the analysis is sequenced: first, the hydraulic capacity of the treatment and disposal systems is evaluated; second, the nitrogen load/concentration; third, the salts as measured by electrical conductivity (ground water) and total dissolved solids (surface water).

- ***Adit water flow rate:*** Each spreadsheet analyzes the current operational and upper-most expected adit flow rate for each alternative. These are intended to give a range of potential water quality and quantity impacts.

- ***Hydraulic and loading analyses:*** The headers for each section are color-coded. The hydraulics analyses headers and conclusions are labeled pale blue, the loading analyses and results are pale green, the ground water headers and results are medium blue, and the surface water headers and results are aqua.

- ***Conclusions:*** Conclusions regarding the option analyzed are in yellow boxes. The adit flow rate analyzed is highlighted in purple. Red text is used where a hydraulic loading capacity or a contaminant standard or recommendation has been exceeded. Please note that for salts, the appropriate unit to determine compliance with standards or the U.S. Forest Service (USFS) recommendation for the protection of trout eggs, are micromhos/centimeter (µmhos/cm) (electrical conductivity) in ground water and milligrams/Liter (mg/L) total dissolved solids (TDS) in surface water. Although both are calculated in the spreadsheets, the applicable projected concentration is highlighted in color.

- ***Option analyzed:*** Next to the headers for each section in grey boxes are descriptions of that portion of the option analyzed. Some options have been split into specific timeframes due to hydraulic or contaminant load sequencing.

- ***Input values and references:*** Below each of the headers are the specific input values used for that portion of the analysis. The values that were used in the calculations are listed in black text and have a descriptor. For the first analysis, and for subsequent analyses where space permitted, a citation for the source of the data is listed to the right in blue text. In an effort to reduce the length of the spreadsheets, the citations for the data are not always located across from the value used, especially where there are several iterations of calculations.

- ***Activity-specific flow rate:*** Both 12-hour and 24-hour flow rates were used, and are designated in the units column. This convention was necessary as some activities, such as adit flow and tailings impoundment dewatering rates, would occur over a 24-hour period, and other activities, such as land application, would occur over a 12-hour period. The volume calculations have been adjusted to reflect whether a 12-hour or 24-hour flow rate was used. For example, to calculate a volume based on a 12-hour rate, 720 minutes per day rate was used. To calculate a volume based on a 24-hour rate, 1,440 minutes per day rate was used. Similarly, loading calculations use the conversion factor 0.012 for a 24-hour gallon per minute rate, while the same calculation for a 12-hour gallon per minute pumping rate uses the conversion factor 0.006.

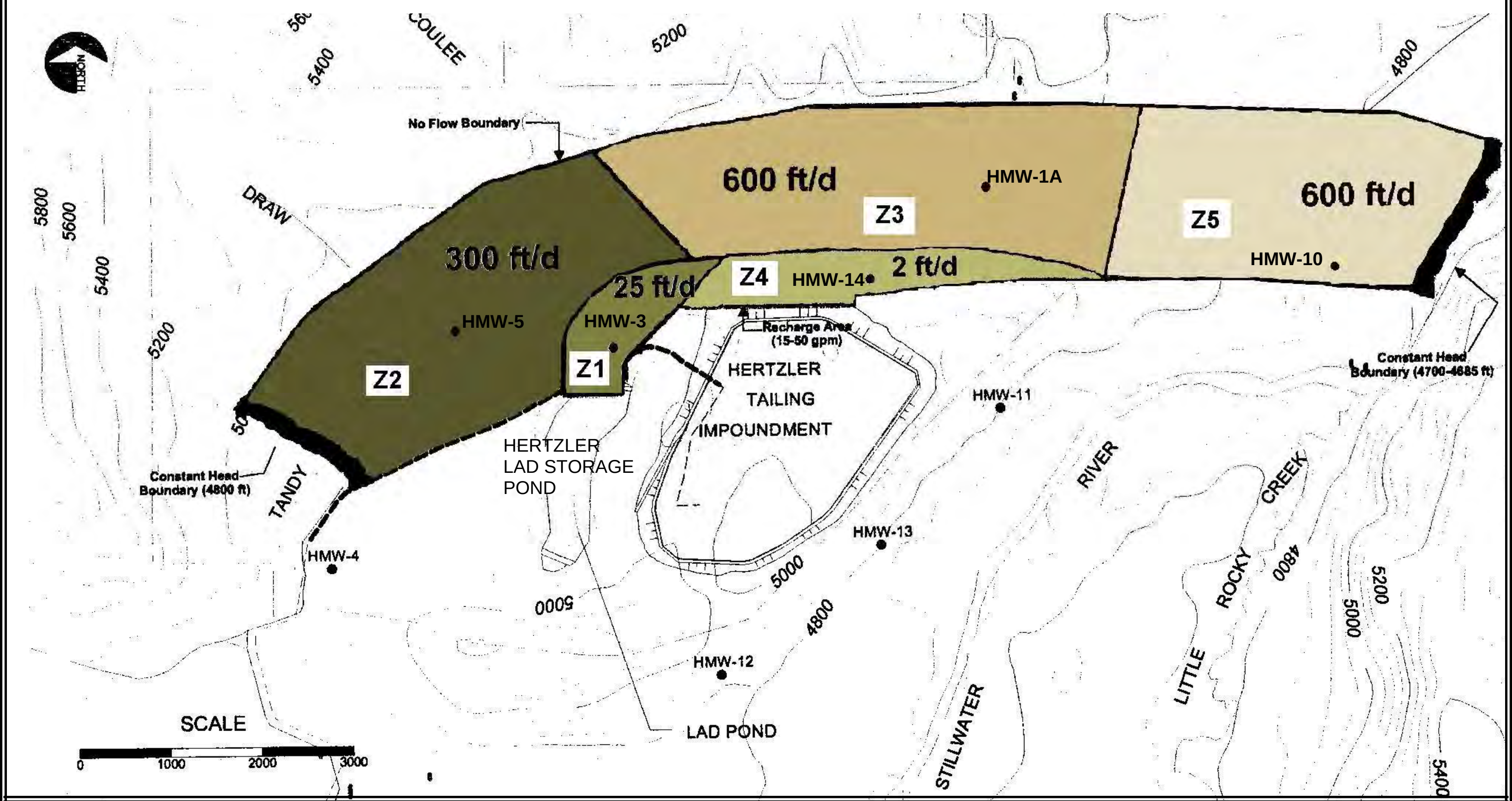
- ***Conversion factors:*** Standard conversion factors (weight, volume, time, loading) have been used.

- ***Significant figures:*** Minimal digits were displayed in an effort to address concerns relating to the precision of these calculations and the degree of accuracy inherently attributed to numbers with expansive extensions to the right of the decimal point. While not strictly adhering to the rules of significant figures, care has been taken to display digits appropriate to the calculation made.

- ***Plant uptake and snowmaking credits:*** The microbial uptake of nitrogen during land application of mine waste waters has been quantified during tests at the Hertzler Ranch LAD system and snowmaking at the East Boulder Mine, so factors based upon the results of those tests have been applied to the appropriate calculations.

Limitations: Please note that these calculations are reasonable projections of changes that can be expected in ground and surface water quality from the disposal of waste waters from SMC's mines. While spreadsheet modeling is valuable to provide good predictions within ground and surface water systems, it does have some limitations. These limitations are most apparent under the following circumstances: when aquifers are highly heterogeneous, which causes differences in permeability and the behavior of ground water; when a three-dimensional approach is needed (these models are two-dimensional); or when the contaminant concentration changes (is attenuated) due to interactions with soil, microbes, or ground and surface water. These types of situations are more accurately represented by a complex (potentially three-dimensional) model. Spreadsheet models are best used in situations such as this analysis, where the salts and nitrogen are conservative (that is, they do not degrade or are otherwise attenuated in the ground water system), temporal relationships are generally known, and for simple ground water or stream flow mixing calculations. These spreadsheet models do not provide temporal estimates, so the agencies have relied upon trends in water quality monitoring data.

L.M.B.



HERTZLER RANCH LAD GROUND WATER ZONES FIGURE

Stillwater Mine System Coordinates 532,000 N, 926,125 E

Appendix C

DEQ 2009

adapted from Hydrometrics 2003 Hertzler LAD Holding Pond Seepage Analysis Figure 4 Numerical Model Layout

Spreadsheet 1A Nitrogen: Alternative 1A No Action Stillwater Mine and Hertzler Ranch Closure and Post-Closure Nitrogen Analyses

Per SMC 1994b, preferential disposal of adit waters is at the Stillwater Mine percolation ponds with the option to route to the Hertzler Ranch LAD for disposal. The calculations for these analyses have been made according to the regulatory requirements for surface and ground water mixing zones of the Montana Water Quality Act and Rules and Federal Clean Water Act. The Stillwater MPDES permit limit is for total nitrogen. No dilution from precipitation (recharge) was assumed. For the Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer; no unsaturated zone was considered. To determine the concentration of total nitrogen in ground water, it was assumed that ground water in Zones 1 (Z_1), 2 (Z_2), and 4 (Z_4) flow into 3 (Z_3), then Z_3 flows into Zone 5 (Z_5) (see the Hertzer Ranch Ground Water Zones Figure). The subscript on input parameters for these calculations refers to the ground water zone, that is, k_1 refers to the hydraulic conductivity of Zone 1 (Z_1), k_2 refers to the hydraulic conductivity of Zone 2 (Z_2) etc. Z_1 is downgradient of the assumed LAD Storage Pond liner leak; Z_2 is the Upper LAD Area; Z_3 is the Lower LAD Area; Z_4 is downgradient of the assumed Hertzler Ranch tailings impoundment liner leak; Z_5 is downgradient of all contributing areas. If treated adit water is routed to Hertzler Ranch, water is routed to the LAD storage pond then to LAD pivots during closure. The existing volume of treated adit water in the LAD storage pond at closure would be 100 MG. Tailings waters for each impoundment would be evaporated over the tailings mass in this alternative and would not discharge to ground water. The concentration of treated adit water is based on historical nitrogen loading and will vary with flow rate.

Closure: **No Action Alternative 1A, Option 1, 2,020 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm of untreated east side adit water would be at the Stillwater Mine percolation ponds. Disposal of 1,770 gpm treated west side adit water and 100 million gallons (MG) of Hertzler Ranch LAD storage pond treated adit water would be at Hertzler Ranch LAD area. The closure timeframe was not specified.**

50 lbs/day	historical maximum combined discharged load post BTS from Stillwater Mine
1,770 gpm (24 hr)	adit flow rate at closure
2.4 mg/L	projected concentration of adit water given loading, flow rate at closure

Hydraulic Input Parameters for Hertzler Ranch Ground Water Calculations

Parameter	Value	Source of Data
depth of aquifer, **D**	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, k_1 beneath Hertzler Ranch LAD Pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, k_2 from upper Hertzler Ranch LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, k_3 and k_5 from lower Hertzler Ranch LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, k_4 area beneath presumed tailings impoundment liner leakage	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of source (Hertzler Ranch LAD storage pond liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of Hertzler Ranch LAD storage pond liner leakage mixing zone, W_1	167 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
angle of dispersion	0.08748866 tan 5°	allowed by ARM 17.30.517(d)
length of presumed Hertzler Ranch LAD Storage Pond liner leakage area, L_1	1,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
length upper Hertzler Ranch LAD, L_2	4,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of upper Hertzler Ranch LAD at P3	1,749 ft	personal communication R Weimer 3/17/2009
width of Upper Hertzler Ranch LAD mixing zone W_2	2,169 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of lower Hertzler Ranch LAD, L_3	5,200 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of Lower Hertzler Ranch LAD at P4	1,610 ft	personal communication R Weimer 3/17/2009
Width of Lower Hertzler Ranch LAD mixing zone W_3	2,065 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
Width of source (Hertzler Ranch tailings impoundment liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of mixing zone below Hertzler Ranch tailings impoundment liner leakage W_4	124 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of presumed Hertzler Ranch Tailings Impoundment liner leakage zone, L_4	1,300 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of mixing zone to Stillwater River W_5	2,215 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length below zone to Stillwater River, L_5	3,600 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width below zone to Stillwater River	1,900 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
cross sectional area of aquifer beneath presumed Hertzler Ranch LAD storage pond liner leakage, A_1	2,512 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer beneath upper Hertzler Ranch LAD, A_2	32,534 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer beneath lower Hertzler Ranch LAD, A_3	30,974 ft^2	D * W, allowed by ARM 17.30.517(d)

cross sectional area of aquifer beneath presumed Hertzler Ranch tailings impoundment liner leakage, $\mathbf{A_4}$	1,856 ft^2		D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer downgradient of all sources, $\mathbf{A_5}$	33,224 ft^2		D * W, allowed by ARM 17.30.517(d)
Q_1=kiA, Ground water available for mixing in Zone 1; includes presumed Hertzler Ranch LAD storage pond liner leakage	628 ft^3/d		calculation per Rule 17.30.517(d)
Q_2=kiA, Ground water available for mixing in Zone 2; beneath upper Hertzler Ranch LAD	97,603 ft^3/d		calculation per Rule 17.30.517(d)
Q_3=kiA, Ground Water available for mixing in Zone 3, beneath lower Hertzler Ranch LAD	185,845 ft^3/d		calculation per Rule 17.30.517(d)
Q_4=kiA, Ground Water available for mixing in Zone 4, beneath presumed tailings impoundment liner leakage	37 ft^3/d		calculation per Rule 17.30.517(d)
Q_5=kiA, Ground Water available for mixing in zone 5, downgradient of all sources to Stillwater River	199,346 ft^3/d		calculation per Rule 17.30.517(d)

Hydraulic Loading to Hertzler Ranch LAD: all water disposed in this alternative was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water

Hertzler Ranch LAD Storage Pond volume	100 MG	111,408 ft^3 (12 hr)	Hertzler Ranch LAD 12-hour dewater rate used to compare with 12-hour Hertzler Ranch LAD application rate
rate to dewater Hertzler Ranch LAD storage pond in 120 days	1,157 gpm (12 hr)	2.4 mg/L	concentration of Hertzler Ranch LAD pond post BTS
maximum Hertzler Ranch LAD Pond volume 100 MG	13,368,984 ft^3	1,770 gpm (24 hr)	west side adit flow rate
days to dewater the Hertzler Ranch LAD storage pond at 2,750 gpm	51 days	2,750 gpm (12 hr)	application rate; operational max total is 2,750 gpm based on maximum design for pivots
rate of water entering Hertzler Ranch LAD storage pond	1,770 gpm (24 hr)	1,375 gpm (24 hr)	24 hour rate of application discharged from Hertzler Ranch LAD storage pond

With an adit flow rate of 2,020 gpm the hydraulic load is greater than the LAD design flow; these flows cannot be managed solely at Hertzler Ranch because the capacity of the Hertzler Ranch LAD storage pond would be exceeded in 53 days. To dispose of this hydraulic load at closure, other options would have to be implemented, such as disposing of some of the treated waters at the Stillwater Mine percolation ponds or extending the time frame for closure.

Ground water nitrogen concentrations at Hertzler Ranch LAD

The calculations in this section are made for the 100 MG of treated adit water stored in the Hertzler Ranch LAD storage pond, dewatered at the maximum 2,750 gpm (12 hr) LAD application rate for 51 days

Ground Water nitrogen concentration area Z_1 (below presumed Hertzler Ranch LAD storage pond liner leak), $\mathbf{C_1}$	2.6 mg/L	nitrogen concentration for Ground Water zone Z_1
Ground Water nitrogen concentration area Z_2 (below upper Hertzler Ranch LAD), $\mathbf{C_2}$	1.7 mg/L	nitrogen concentration for Ground Water zone Z_2
Ground Water nitrogen concentration area Z_4 (below presumed Hertzler Ranch tailings impoundment liner leak), $\mathbf{C_4}$	3.4 mg/L	nitrogen concentration for Ground Water zone Z_4
Ground Water nitrogen concentration in Z_3 at HMW-10 from Z_1, Z_2, Z_3, Z_4 (downgradient of all sources to Stillwater River), C_3	**1.3 mg/L**	nitrogen concentration for Ground Water zone Z_3 at TN compliance point HMW-10
nitrogen concentration in ground water at Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4), $\mathbf{C_5}$	1.0 mg/L	nitrogen concentration in ground water just prior to discharge into the Stillwater River at 2,750 gpm Hertzler Ranch LAD application rate

The concentration of total nitrogen in ground water below the Hertzler Ranch LAD meets DEQ-7 ground water criteria of 10 mg/L.

Surface water nitrogen concentrations in the Stillwater River below Hertzler Ranch LAD	**The calculations in this section are made for the 100 MG of treated adit water stored in the Hertzler Ranch LAD storage pond, dewatered at the maximum 2,750 gpm (12 hr) LAD application rate for 51 days**				
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2	cfs	7Q10 at mine site 31.2 cfs; the actual concentration at Hertzler Ranch SMC-13 would be less due to higher streamflow
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.4	mg/L			median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient total inorganic nitrogen is 0.14 mg/L
discharge volume through aquifer, $\mathbf{Q_d}$	669,139	ft^3/d	7.7	cfs	
discharge concentration to Stillwater River, $\mathbf{C_d}$	1.0	mg/L			
Stillwater River total nitrogen concentration below Hertzler Ranch LAD	**0.5**	**mg/L**			
The concentration of total nitrogen in surface water below the Hertzler Ranch LAD is less than 1.0 mg/L					
total nitrogen load disposed at Hertzler Ranch LAD from 100 MG stored treated adit waters	**1,963**	lbs/yr			

No Action Alternative 1A, Option 2, 2,020 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 2,020 gpm (250 gpm of untreated east side and 1,770 gpm of treated west side) adit water would be at the Stillwater Mine percolation ponds. Disposal of 100 MG of Hertzler Ranch LAD storage pond treated adit water would be at the Hertzler Ranch LAD area. The closure timeframe was not specified.

contribution of adit water to Stillwater River nitrogen load	50.6	lbs/day	
Waste Rock Dump contribution	11.0	lbs/day	
total nitrogen load at Stillwater Mine	**62**	lbs/day	no water quality implications; discharge meets MPDES permit 100 lbs/day nitrogen limit
The total nitrogen load at the Stillwater Mine is less than the MPDES permit limit of 100 lbs/day.			
total TN load disposed at Hertzler Ranch LAD from 100 MG stored treated adit waters	**1,963**	lbs/yr	

No Action Alternative 1A Option 1, 650 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm untreated east side adit water to the Stillwater Mine east side percolation ponds. Disposal of 400 gpm and 100 MG of treated west side adit water stored in the Hertzler Ranch LAD storage pond would be at the Hertzler Ranch LAD area. The closure timeframe was not specified.

Hydraulic Loading to Hertzler Ranch LAD: all water disposed in this alternative was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water

volume of water in Hertzler Ranch LAD storage pond prior to closure	100	MG	**250**	gpm (24 hr)	east side adit waters
24 hr rate to dewater Hertzler Ranch LAD storage pond in 120 days	**579**	gpm (24 hr)	**1,157**	gpm (12 hr)	rate to dewater 100 MG Hertzler Ranch LAD Storage pond in 120 days
west side adit flow rate	**400**	gpm (24 hr)	**800**	gpm (12 hr)	west side adit flow rate (to compare with LAD rate)
24 hr rate of water entering the Hertzler Ranch LAD storage pond	**979**	gpm (24 hr)	**1,957**	gpm (12 hr)	rate of water entering the Hertzler Ranch LAD storage pond
24 hr rate of LAD at Hertzler Ranch	**1,375**	gpm (24 hr)	**2,750**	gpm (12 hr)	rate of LAD at Hertzler Ranch
rate to dewater Hertzler Ranch LAD storage pond at full capacity of LAD	**396**	gpm (24 hr)	**793**	gpm (12 hr)	excess available LAD capacity to dewater Hertzler Ranch LAD storage pond (12 hr rate)
number of days to dewater Hertzler Ranch LAD storage pond	**71**	**days**			
The hydraulic load of 400 gpm (24 hr) adit water plus 979 gpm (24 hr) Hertzler Ranch LAD storage pond water can be disposed of at Hertzler Ranch LAD					
			50	lbs/day	historical maximum combined discharged load post BTS from Stillwater Mine
			10.4	mg/L	projected concentration of adit water given loading, flow rate at closure (historical max)

Hydraulic Input Parameters for Hertzler Ranch Ground Water Calculations		**Hydraulic Loading to Hertzler Ranch LAD: 100 MG was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water plus 400 gpm treated adit water**
depth of aquifer, **D**	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, $\mathbf{k_1}$ beneath LAD Pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_4}$ area beneath presumed tailings impoundment liner leakage	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of source (presumed Hertzler Ranch LAD storage pond liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of Hertzler Ranch LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
angle of dispersion	0.08748866 tan 5°	allowed by ARM 17.30.517(d)
length of presumed Hertzler Ranch LAD Storage Pond liner leakage area, $\mathbf{L_1}$	1,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
length upper Hertzler Ranch LAD, $\mathbf{L_2}$	4,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of upper Hertzler Ranch LAD at P3	1,749 ft	personal communication R Weimer 3/17/2009
width of Upper Hertzler Ranch LAD mixing zone $\mathbf{W_2}$	2,169 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of lower Hertzler Ranch LAD, $\mathbf{L_3}$	5,200 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of Lower Hertzler Ranch LAD at P4	1,610 ft	personal communication R Weimer 3/17/2009
Width of Lower Hertzler Ranch LAD mixing zone $\mathbf{W_3}$	2,065 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
Width of source (Hertzler Ranch tailings impoundment liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of mixing zone below Hertzler Ranch tailings impoundment liner leakage $\mathbf{W_4}$	124 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of presumed Hertzler Ranch Tailings Impoundment liner leakage zone, $\mathbf{L_4}$	1,300 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of mixing zone to Stillwater River $\mathbf{W_5}$	2,215 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length below zone to Stillwater River, $\mathbf{L_5}$	3,600 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width below zone to Stillwater River	1,900 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
cross sectional area of aquifer beneath presumed Hertzler Ranch LAD storage pond liner leakage, $\mathbf{A_1}$	2,512 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer beneath upper Hertzler Ranch LAD, $\mathbf{A_2}$	32,534 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer beneath lower Hertzler Ranch LAD, $\mathbf{A_3}$	30,974 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer beneath presumed Hertzler Ranch tailings impoundment liner leakage, $\mathbf{A_4}$	1,856 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer downgradient of all sources, $\mathbf{A_5}$	33,224 ft^2	D * W, allowed by ARM 17.30.517(d)
$\mathbf{Q_1=kiA}$, Ground Water available for mixing in Zone 1 beneath presumed Hertzler Ranch LAD storage pond liner leakage	628 ft^3/d	calculation per Rule 17.30.517(d)

Q_2=kiA, Ground Water available for mixing in Zone 2 beneath upper Hertzler Ranch LAD	97,603 ft^3/d		calculation per Rule 17.30.517(d)
Q_3=kiA, Ground Water available for mixing in Zone 3 beneath lower Hertzler Ranch LAD	185,845 ft^3/d		calculation per Rule 17.30.517(d)
Q_4=kiA, Ground Water available for mixing in Zone 4 beneath presumed tailings impoundment liner leakage	37 ft^3/d		calculation per Rule 17.30.517(d)
Q_5=kiA, Ground Water available for mixing in Zone 5 downgradient of all sources to Stillwater River	199,346 ft^3/d		calculation per Rule 17.30.517(d)
Hertzler Ranch LAD Storage Pond volume	100 MG	111,408 ft^3/12 h	Hertzler Ranch LAD 12 hour dewater rate used to compare with 12 hour Hertzler Ranch LAD application rate
rate to dewater Hertzler Ranch LAD storage pond in 120 days	1,157 gpm (12 hr)	10.4 mg/L	concentration of Hertzler Ranch LAD pond post BTS
maximum Hertzler Ranch LAD Pond volume 100 MG	13,368,984 ft^3		NOTE: for 12 hour application rate (720 min/day)--operational max total is 2,700 gpm
days to dewater the Hertzler Ranch LAD storage pond at 2,750 gpm 12 hr rate	51 days		based on max rate of pivot discharge
Nitrogen Concentration Input parameters and assumptions for calculations at Hertzler Ranch			
concentration of nitrogen in ambient ground water at Hertzler Ranch, $\mathbf{C_A}$	0.2 mg/L		SMC operational monitoring data
concentration of nitrogen in Hertzler Ranch Tailings impoundment liner leakage, $\mathbf{C_4}$	4 mg/L		SMC operational monitoring data
concentration of nitrogen in Hertzler Ranch LAD discharge post plant uptake (80% credit), $\mathbf{C_2}$, $\mathbf{C_3}$	3.0 mg/L		Hertzler Ranch LAD pond concentration, calculated
concentration of nitrogen in Hertzler Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	10.4 mg/L	1,600 gpm (12 hr)	12 hour application rate (720 min/day) of upper Hertzler Ranch LAD discharge
volume upper Hertzler Ranch LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d	33,690 ft^3/d	P1; 350 gpm application rate in ft^3/day
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	38,503 ft^3/d	P2: 400 gpm application rate in ft^3/day
volume of Hertzler Ranch LAD Storage Pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	81,818 ft^3/d	P3; 850 gpm application rate in ft^3/day
volume lower Hertzler Ranch LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487 ft^3/d	43,316 ft^3/d	P4, P5; 450 gpm application rate in ft^3/day
total load of nitrogen disposed at Hertzler Ranch during closure	**8,688** lbss/yr	24,064 ft^3/d	P6; 250 gpm application rate in ft^3/day
application rate (720 min/day) of lower Hertzler Ranch LAD discharge	1,150 gpm (12 hr)	0 gpm (12 hr)	volume percolated
Ground Water concentrations at Hertzler Ranch			**Nitrogen Loading to Hertzler Ranch LAD: all water disposed in this alternative was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water**
Ground Water concentration area $\mathbf{Z_1}$ (below presumed Hertzler Ranch LAD storage pond liner leak), $\mathbf{C_1}$	2.6 mg/L		nitrogen concentration for Ground Water zone Z_1
Ground Water concentration area $\mathbf{Z_2}$ (below upper Hertzler Ranch LAD), $\mathbf{C_2}$	1.7 mg/L		nitrogen concentration for Ground Water zone Z_2
Ground Water concentration area Z_4 (below presumed Hertzler Ranch tailings impoundment liner leak), $\mathbf{C_4}$	3.4 mg/L		nitrogen concentration for Ground Water zone Z_4
Ground Water concentration in Z_3 at HMW-10 from Z_1, Z_2, Z_3, Z_4 (downgradient of all sources to Stillwater River); C_3	**1.3 mg/L**		nitrogen concentration for Ground Water zone Z_3 at nitrogen compliance point HMW-10; Hertzler Ranch LAD application rate 2,750 gpm
concentration in ground water at $\mathbf{Z_5}$ from upgradient sources (Z_1, Z_2, Z_3, Z_4), $\mathbf{C_5}$	1.0 mg/L		nitrogen concentration in ground water just prior to discharge into the Stillwater River at 2,750 gpm Hertzler Ranch LAD application rate

The concentration of total nitrogen in ground water below the Hertzler Ranch LAD meets DEQ-7 ground water criteria of 10 mg/L.

Stillwater River nitrogen calculations below Hertzler Ranch LAD			**Nitrogen Loading to Hertzler Ranch LAD: all water disposed in this alternative was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water**
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs; actual conc. at Hertzler Ranch SMC-13 would be less; higher streamflow
receiving stream ambient total nitrogen concentration, C_s	0.4 mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TN is 0.14 mg/L
ground water discharge volume, Q_d	669,139 ft^3/d	7.7 cfs	
discharge concentration to Stillwater River, C_d	0.97 mg/L		
Stillwater River Nitrogen concentration below Hertzler Ranch LAD	**0.5 mg/L**		

The concentration of total nitrogen in the Stillwater River below the Hertzler Ranch LAD is less than 1.0 mg/L.

Stillwater River Nitrogen loading at the Stillwater Mine		**This nitrogen loading is from the 200 gpm (24 hr) east side adit water flow and the waste rock dumps**
contribution of adit water to Stillwater River nitrogen load	0.6 lbs/day	
Waste Rock Dump contribution, estimated	11.0 lbs/day	Hertzler Ranch LAD EIS
daily nitrogen load from waste rock at Stillwater Mine	**12** lbs/day	no water quality or quantity implications because the load is less than the MPDES 100 lbs/day nitrogen limit

The nitrogen loading to the Stillwater River at the Stillwater Mine is less than the MPDES permit total nitrogen load limit of 100 lbs/day.

POST CLOSURE Total Nitrogen concentrations in surface and ground water at Stillwater Mine, 2,020 gpm adit water

2,020 gpm adit water: West side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 25.3 mg/L Total Nitrogen. East side adit water quality is assumed to be at non-detectable concentrations. Analysis assumes all adit water is percolated at the East Side and Stillwater Valley Ranch percolation ponds, or discharged directly to the Stillwater River.

post closure nitrogen concentration of untreated west side adit water, C_{WPC}	25.3 mg/L	0.01 mg/L	post closure total nitrogen concentration of untreated east side adit water, C_{EPC}
post closure west side adit flow rate	**1,770** gpm (24 hr)	**250** gpm (24 hr)	post closure east side adit flow rate
post closure west side adit, 1000 gpm flow rate	192,513 ft^3/d	48,128 ft^3/d	post closure east side adit flow rate
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, k_{SVR}	4076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, k_E	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, L_{SVR}	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, W_{SVR}	507 ft		2008 MPDES Permit page 3
length of mixing zone, L_E	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, W_E	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, A_{SVR}	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_E	9,750 ft		D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones

POST CLOSURE nitrogen concentration in ground water at Stillwater Mine

1996-2008 MW-10A median concentration of TN in Stillwater Mine ground water, **C_A**	0.1 mg/L		
projected ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	16 mg/L		
POST CLOSURE ground water nitrogen concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	14 mg/L		**projected concentration of ground water at MW-17A if 1,770 gpm untreated west side adit water were percolated at the Stillwater Mine post closure**

POST CLOSURE If 2,020 gpm untreated adit water were percolated at the Stillwater Mine, the concentration of Total Nitrogen in the ground water would exceed the 10 mg/L DEQ-7 ground water standard at the end of the mixing zone. To meet the 10 mg/L standard at the end of the mixing zone, the untreated concentration of 1,770 gpm west side adit water must be 18 mg/L or less. Based on the nitrogen decline curve, this discharge would meet criterion approximately 22 months after closure.

receiving streamflow, **Q_s**	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, **C_s**	0.3 mg/L		median ambient total nitrogen concentration at SMC-1A 1986-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN is 0.06 mg/L
ground water discharge volume, **Q_d**	606,396 ft^3/d	7.0 cfs	discharge volume of ground water in cubic feet per second
ground water discharge concentration to Stillwater River, **C_d**	14.2 mg/L		projected concentration of ground water just prior to discharge
POST CLOSURE Stillwater River nitrogen concentration at Stillwater Mine from PERCOLATION of 2,020 gpm untreated adit water	2.9 mg/L		**projected concentration in the Stillwater River if 1,770 gpm untreated west side adit water were percolated at the Stillwater Mine**

POST CLOSURE If 2,020 gpm untreated adit water were percolated at the Stillwater Mine, the concentration of total nitrogen in the Stillwater River would exceed the 1 mg/L limit set by the MPDES permit. To meet the 1 mg/L limit in the Stillwater River, the concentration of 1,770 gpm untreated west side adit water must be 7 mg/L or less. Based on the nitrogen decline curve, this dischage would meet the surface water criterion 48 months after closure.

POST CLOSURE Stillwater River TN concentration at Stillwater Mine from DIRECT DISCHARGE of 2,020 gpm untreated adit water	3.1 mg/L		**projected concentration in the Stillwater River if 1,770 gpm untreated west side adit water were DIRECTLY DISCHARGED INTO the Stillwater River**

POST CLOSURE If 2,020 gpm untreated adit water were directly discharged into the Stillwater River at the mine, the concentration of total nitrogen in the Stillwater River would exceed the 1 mg/L limit set by the MPDES permit. To meet the 1 mg/L limit in the Stillwater River, the concentration of 1,770 gpm untreated west side adit water must be 6.5 mg/L or less. Based on the nitrogen decline curve, this discharge would meet the Total Nitrogen criterion 48 months after closure.

POST CLOSURE Total Nitrogen concentrations in surface and ground water at Stillwater Mine, 650 gpm adit water

650 gpm adit water: West side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 25.3 mg/L Total Nitogen. East side adit water quality is assumed to be at non-detectable concentrations. Analysis assumes all adit water is percolated at the East Side and Stillwater Valley Ranch percolation ponds, or discharged directly to the Stillwater River.

post closure nitrogen concentration of untreated west side adit water, **C_{WPC}**	25.3 mg/L	0.01 mg/L	post closure nitrogen concentration of untreated east side adit water, **C_{EPC}**
post closure west side adit flow rate	**400** gpm (24 hr)	**250** gpm (24 hr)	post closure east side adit flow rate
post closure west side adit flow rate	77,005 ft^3/d	48,128 ft^3/d	post closure east side adit flow rate
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, **k_{SVR}**	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, **k_E**	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, **L_{SVR}**	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, **W_{SVR}**	507 ft		2008 MPDES Permit page 3
length of mixing zone, **L_E**	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, **W_E**	650 ft		2008 MPDES Permit page 4

cross sectional area of aquifer, A_{SVR}	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_E	9,750 ft		D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
POST CLOSURE nitrogen concentration in ground water at Stillwater Mine			
projected ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	12 mg/L	0.1 mg/L	1996-2008 MW-10A median concentration of TN in ground water at Stillwater Mine, C_A
POST CLOSURE ground water projected concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	**5.7** mg/L	**650 gpm untreated west side adit water were percolated at the Stillwater Mine post closure**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient TN concentration, C_s	0.31 mg/L		median ambient total nitrogen concentration at SMC-1A 1986-2008 SMC monitoring data
ground water discharge volume, Q_d	342,653 ft^3/d	4.0 cfs	ground water discharge volume in cubic feet per second
ground water discharge concentration to Stillwater River, C_d	5.7 mg/L		projected concentration of ground water just prior to discharge
POST CLOSURE Stillwater River nitrogen projected concentration at Stillwater Mine from PERCOLATION of 650 gpm untreated adit water	**0.9** mg/L	**projected concentration in the Stillwater River if 650 gpm untreated adit water were percolated at the Stillwater Mine**	
POST CLOSURE If 650 gpm untreated adit water were percolated at the Stillwater Mine, the concentration of Total Nitrogen in the Stillwater River would be less than the 1 mg/L limit set by the MPDES permit.			
POST CLOSURE Stillwater River nitrogen projected concentration at Stillwater Mine from DIRECT DISCHARGE of 650 gpm untreated adit water	**1.0** mg/L	**projected concentration in the Stillwater River if 650 gpm untreated adit water were DIRECTLY DISCHARGED INTO the Stillwater River**	
POST CLOSURE If 650 gpm untreated adit water were directly discharged into the Stillwater River at the mine, the concentration of Total Nitrogen in the Stillwater River would equal the 1 mg/L limit set by the MPDES permit.			

Spreadsheet 1A Salts: Alternative 1A No Action Stillwater Mine and Hertzler Ranch LAD Salinity Closure and Post-Closure Analyses

Per SMC 1994b, preferential disposal of adit waters is at the mine site via percolation ponds with the option to route to the Hertzler Ranch LAD for disposal. For Hertzler Ranch, the assumptions for these ground water mixing calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act. No dilution from precipitation (recharge) was assumed. For Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer (no unsaturated zone was considered). To determine the concentration of TDS in ground water, it was assumed that Zone 1 (Z_1), Z_2, and Z_4 flow into Z_3, then Z_3 flows into Z_5 (see the Hertzler Ranch LAD Ground Water Zones Figure). The subscript on input parameters for these calculations refers to the ground water zone; that is, k_1 refers to the hydraulic conductivity of Zone 1, k_2 refers to the hydraulic conductivity of Zone 2 (Z_2). Z_1 is below a presumed Hertzler Ranch LAD storage pond leak; Z_2 is the upper Hertzler Ranch LAD area; Z_3 is the lower Hertzler Ranch LAD area, Z_4 is below the Hertzler tailings impoundment liner leak; Z_5 is downgradient of all contributing areas. Treated adit water is routed to the Hertzler Ranch LAD storage pond then to LAD pivots during closure. The existing volume of treated adit water in the LAD storage pond at closure is assumed to be 100 million gallons (MG). These analyses assume liner leakage contribution from the Hertzler Ranch Tailings impoundment and Hertzler Ranch LAD storage pond. The tailings waters for each impoundment would be evaporated over the tailings mass and not discharged to ground water. The concentration of TDS in adit water is assumed to be the median concentration based on SMC Monitoring data. The concentration of TDS in both tailings waters at closure is assumed to equal operational concentrations. TDS is used for surface waters and EC is used for ground waters.

No Action Alternative 1A, Option 1, 2,020 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm of untreated east side adit water would be at the Stillwater Mine percolation ponds. Disposal of 1,770 gpm treated west side adit water and 100 million gallons (MG) of Hertzler Ranch LAD storage pond treated adit water would be at Hertzler Ranch LAD area. The closure timeframe was not specified.

Value	Unit	Description
1,770	gpm (24 hr)	west side adit flow rate at closure
250	gpm (24 hr)	east side adit flow rate at closure
250	mg/L	average 2004-2008 Stillwater East side adit water TDS concentration, SMC Monitoring Data
491	mg/L	median Stillwater TDS west side adit water concentration, SMC Monitoring Data
1,870	mg/L	concentration of TDS in Hertzler tailings waters

Input Parameters for Hertzler Ground Water Calculations		**Source of Data**
depth of aquifer, **D**	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, $\mathbf{k_1}$ beneath LAD Pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_4}$ from tailings impoundment liner leakage	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of source (LAD storage pond liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
angle of dispersion	0.087488664 tan 5°	allowed by ARM 17.30.517(d)
length of LAD Storage Pond liner leakage area, $\mathbf{L_1}$	1,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
length upper LAD, $\mathbf{L_2}$	4,800 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of upper LAD at P3	1,749 ft	personal communication R Weimer 3/17/2009
width of Upper LAD mixing zone $\mathbf{W_2}$	2,169 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of lower LAD, $\mathbf{L_3}$	5,200 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width of Lower LAD at P4	1,610 ft	personal communication R Weimer 3/17/2009
Width of Lower LAD mixing zone $\mathbf{W_3}$	2,065 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
Width of source (Hertzler tailings impoundment liner leakage)	10 ft	assumed width based on point liner leak, Hydrometrics 2003
width of mixing zone below Hertzler tailings impoundment liner leakage $\mathbf{W_4}$	124 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of W_4 zone, $\mathbf{L_4}$	1,300 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003

width of Mixing Zone to Stillwater River W_5	2,215 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length below lower LAD, L_5	3,600 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
width below lower LAD	1,900 ft	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
cross sectional area of aquifer, A_1	2,512 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer, A_2	32,534 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer, A_3	30,974 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer, A_4	1,856 ft^2	D * W, allowed by ARM 17.30.517(d)
cross sectional area of aquifer, A_5	33,224 ft^2	D * W, allowed by ARM 17.30.517(d)
Q_1=kiA, ground water available for mixing from Zone 1	628 ft^3/d	calculation per Rule 17.30.517(d)
Q_2=kiA, ground water available for mixing from Zone 2	97,603 ft^3/d	calculation per Rule 17.30.517(d)
Q_3=kiA, ground water available for mixing from Zone 3	185,845 ft^3/d	calculation per Rule 17.30.517(d)
Q_4=kiA, ground water available for mixing from Zone 4	37 ft^3/d	calculation per Rule 17.30.517(d)
Q_5=kiA, ground water available for mixing from Zone 5	199,346 ft^3/d	calculation per Rule 17.30.517(d)

Hydraulic Loading to Hertzler LAD: all water disposed in this alternative was in the Hertzler Ranch LAD Storage Pond over the winter and is treated adit water.
The Hydraulic Loading calculations for this scenario are listed on Spreadsheet 1A Nitrogen. The calculations indicate that an adit flow rate of 2,020 gpm exceeds the hydraulic capacity of Hertzler Ranch LAD and other water balance options must be pursued. For brevity, those hydraulic loading calculations are not repeated here.

Ground Water salts concentrations at Hertzler Ranch LAD		**The calculations in this section are made for the 100 MG of treated adit water stored in the Hertzler Ranch LAD storage pond, dewatered at the maximum 2,750 gpm (12 hr) LAD application rate for 51 days.**	
Ground Water concentration area Z_1 (below presumed Hertzler Ranch LAD storage pond liner leak), C_1	230 mg/L	359 µmhos/cm	EC for Ground Water zone Z_1
Ground Water concentration area Z_2 (below upper Hertzler Ranch LAD), C_2	439 mg/L	685 µmhos/cm	EC for Ground Water zone Z_2
Ground Water concentration area Z_4 (below presumed Hertzler Ranch tailings impoundment liner leak), C_4	1,593 mg/L	**2,484** µmhos/cm	EC for Ground Water zone Z_4; **this EC value exceeds the Class I Beneficial Use Criterion of 1,000 µmhos/cm**
Ground Water EC in Z_3 (HMW-10) from Z_1, Z_2, Z_3, Z_4 (downgradient of all sources to Stillwater River), C_3	368 mg/L	**575** µmhos/cm	EC for Ground Water zone Z_3 at compliance point HMW-10 meets the Class I Beneficial Use criteria of 1,000 µmhos/cm
concentration in ground water at Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4), C_5	303 mg/L	473 µmhos/cm	TDS concentration and EC in ground water just prior to discharge into the Stillwater River at 2,750 gpm Hertzler Ranch LAD application rate

The EC of ground water from disposal of stored water in the Hertzler Ranch LAD storage pond meets 1,000 µmhos/cm criterion protective of Class I Beneficial use at the compliance point and the point of discharge to the Stillwater River.

Surface Water salts concentrations in the Stillwater River below Hertzler Ranch LAD		**The calculations in this section are made for the 100 MG of treated adit water stored in the Hertzler Ranch LAD storage pond, dewatered at the maximum 2,750 gpm (12 hr) LAD application rate for 51 days.**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream median ambient concentration SMC-12, C_s	44 mg/L	69 µmhos/cm	1995-2008 SMC Monitoring Data median TDS at SMC-12; EC calculated
ground water discharge volume, Q_d	669,139 ft^3/d	7.7 cfs	ground water flow to stream in cubic feet per second
ground water discharge concentration to Stillwater River, C_d	303 mg/L		
Stillwater River TDS concentration below Hertzler Ranch LAD	**96 mg/L**		

The concentration of TDS in the Stillwater River below Hertzler Ranch is less than the 250 mg/L recommendation protective of trout eggs.

No Action Alternative 1A, Option 2, 2,020 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 2,020 gpm (250 gpm of untreated east side and 1,770 gpm of treated west side) adit water would be at the Stillwater Mine percolation ponds. Disposal of 100 MG of Hertzler Ranch LAD storage pond treated adit water would be at the Hertzler Ranch LAD area. The closure timeframe was not specified.

		1,770	gpm (24 hr)	west side adit flow rate
		491	mg/L	west side adit median TDS concentration
		250	gpm (24 hr)	east side adit flow rate
Ground Water Salts Calculation Input Parameters for the Stillwater Mine		**250**	mg/L	east side adit average TDS concentration 2004-2008
depth of aquifer, **D**	15 ft			Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds (Stillwater Valley Ranch), k_{SVR}	4,076 ft/day			SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, k_E	539 ft/day			SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft			Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone (Stillwater Valley Ranch), L_{SVR}	500 ft			2008 MPDES Permit page 3
width of mixing zone at downgradient extent (Stillwater Valley Ranch), W_{SVR}	507 ft			2008 MPDES Permit page 3
length of mixing zone (east side), L_E	2,000 ft			2008 MPDES Permit page 4
width of mixing zone at downgradient extent (east side), W_E	650 ft			2008 MPDES Permit page 4
cross sectional area of aquifer, (Stillwater Valley Ranch) A_{SVR}	7,605 ft			D * W, allowed by 17.30.517(d)
cross sectional area of aquifer (east side), A_E	9,750 ft			D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing (Stillwater Valley Ranch)	185,988 ft^3/d			calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
$Q_E=k_EiA_E$, ground water available for mixing (east side)	31,532 ft^3/d			calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones

Ground Water salts at the Stillwater Mine		**Disposal of 250 gpm of untreated east side adit water and 1,770 gpm of treated west side adit water at the Stillwater Mine percolation ponds.**		
1986-2008 MW-10A median concentration of TDS in ambient ground water at Stillwater Mine, C_A	81 mg/L	125	µmhos/cm	average EC in ambient ground water at SMC MW-10A
ground water TDS concentration at the end of the Stillwater East Side Percolation Pond mixing zone	419 mg/L	422	µmhos/cm	average EC from percolation of 1000 gpm west side adit waters + 250 gpm east side adit waters
ground water EC at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	331 mg/L	**364**	µmhos/cm	EC from Stillwater East Side percolation plus percolation of 1000 gpm west side adit waters at Stillwater Valley Ranch just prior to discharge to Stillwater River

The EC of ground water at the Stillwater Mine meets the Class I Beneficial Use criterion of 1,000 µmhos/cm.

Surface Water salts concentrations at the Stillwater Mine		**Disposal of 250 gpm of untreated east side adit water and 1,770 gpm of treated west side adit water at the Stillwater Mine percolation ponds.**		
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2	cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	45 mg/L	70	µmhos/cm	2008 MPDES Statement of Basis, p 9; EC calculated
ground water discharge volume, Q_d	606,396 ft^3/d	7.0	cfs	ground water flow to stream in cubic feet per second
discharge concentration to Stillwater River, C_d	331 mg/L	517	µmhos/cm	median Stillwater TDS adit water concentration, SMC Monitoring Data; EC calculated
Stillwater River TDS concentration at Stillwater Mine	**98 mg/L**	152	µmhos/cm	assumes no treatment credit; uses mine site MPDES permit mixing zones for percolation ponds; EC calculated

The TDS concentration in the Stillwater River at the Stillwater Mine is less than the 250 mg/L recommendation protective of trout eggs.

Input parameters and assumptions for EC & TDS calculations at Hertzler Ranch LAD; all other parameters as above			51	days	time to LAD 100 MG Hertzler LAD storage pond water at capacity of Hertzler Ranch LAD
$\mathbf{Q_1}$=kiA, Ground Water available for mixing	628	ft^3/d			calculation per Rule 17.30.517(d)
$\mathbf{Q_2}$=kiA, Ground Water available for mixing	97,603	ft^3/d			calculation per Rule 17.30.517(d)
$\mathbf{Q_3}$=kiA, Ground Water available for mixing	185,845	ft^3/d			calculation per Rule 17.30.517(d)
$\mathbf{Q_4}$=kiA, Ground Water available for mixing	37	ft^3/d			calculation per Rule 17.30.517(d)
$\mathbf{Q_5}$=kiA, Ground Water available for mixing	199,346	ft^3/d			calculation per Rule 17.30.517(d)
concentration of TDS in ambient ground water at Hertzler, $\mathbf{C_A}$	150	mg/L			SMC operational monitoring data
concentration of TDS in Hertzler Tailings impoundment and impoundment liner leakage, $\mathbf{C_4}$	1,870	mg/L			SMC operational monitoring data
concentration of TDS in applied LAD discharge, $\mathbf{C_2}$, $\mathbf{C_3}$	701	mg/L			higher concentration due to evaporation of applied waters through high pressure nozzles
concentration of TDS in LAD storage pond liner leakage, $\mathbf{C_1}$	491	mg/L	1,600	gpm (12 hr)	application rate for upper LAD area
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates $\mathbf{V_2}$	107,807	ft^3/d	33,690	ft^3/d	Pivot P1; 350 gpm application rate (12 hr)
volume of Hertzler tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193	ft^3/d	38,503	ft^3/d	Pivot P2: 400 gpm application rate (12 hr)
volume of LAD Storage Pond liner leakage (1 gpm), $\mathbf{V_1}$	193	ft^3/d	81,818	ft^3/d	Pivot P3; 850 gpm application rate (12 hr)
volume lower LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487	ft^3/d	43,316	ft^3/d	Pivots P4, P5; 450 gpm application rate (12 hr)
ground water TDS concentration at $\mathbf{Z_3}$ (HMW-10 compliance point)	368	mg/L	24,064	ft^3/d	Pivot P6; 250 gpm application rate (12 hr)
ground water EC at Z_3 (HMW-10 compliance point)	**575**	µmhos/cm	**Disposal of 100 MG of treated stored adit waters at Hertzler Ranch LAD area.**		
ground water concentration at $\mathbf{Z_5}$	303	mg/L	473	µmhos/cm	EC and TDS concentration in ground water below Hertzler Ranch LAD just prior to discharge to Stillwater River
The EC of ground water at Hertzler Ranch LAD meets the Class I Beneficial Use criterion of 1,000 µmhos/cm.					
Stillwater River TDS concentration below Hertzler Ranch LAD			**Disposal of 100 MG of treated stored adit waters at Hertzler Ranch LAD area.**		
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2	cfs	7Q10 at mine site 31.2 cfs
receiving stream median ambient concentration SMC-12, $\mathbf{C_s}$	44	mg/L	69	µmhos/cm	1995-2008 SMC Monitoring Data median TDS at SMC-12; EC calculated
ground water discharge volume, $\mathbf{Q_d}$	669,139	ft^3/d	7.7	cfs	ground water flow to stream in cubic feet per second
ground water discharge concentration to Stillwater River, $\mathbf{C_d}$	303	mg/L	473	µmhos/cm	TDS concentration in ground water just prior to discharge to Stillwater River; EC calculated
Stillwater River TDS concentration below Hertzler Ranch LAD	**96**	**mg/L**	149	µmhos/cm	assumes no treatment credit for salts; EC calculated
The TDS concentration in the Stillwater River below Hertzler Ranch LAD is less than the 250 mg/L recommendation protective of trout eggs.					
No Action Alternative 1A Option 1, 650 gpm: Tailings waters would be evaporated over the tailings mass. Disposal of 250 gpm untreated east side adit water to the Stillwater Mine east side percolation ponds. Disposal of 400 gpm and 100 MG of treated west side adit water stored in the Hertzler Ranch LAD storage pond would be at the Hertzler Ranch LAD area. The closure timeframe was not specified.					
volume of water in Hertzler Ranch LAD storage pond prior to closure	100	MG			
rate to dewater Hertzler Ranch LAD storage pond in 120 days	**579**	gpm (24 hr)	**1,157**	gpm (12 hr)	rate to dewater 100 MG Hertzler Ranch LAD Storage pond in 120 days

west side adit flow rate	**400** gpm (24 hr)	**800** gpm (12 hr)	west side adit flow rate (to compare with LAD rate)
rate of water entering the Hertzler Ranch LAD storage pond	979 gpm (24 hr)	1,957 gpm (12 hr)	rate of water entering the Hertzler Ranch LAD storage pond
rate of LAD at Hertzler Ranch	**1,375** gpm (24 hr)	**2,750** gpm (12 hr)	rate of LAD at Hertzler Ranch
rate to dewater Hertzler Ranch LAD storage pond at full capacity of LAD	**975** gpm (24 hr)	**1,950** gpm (12 hr)	excess available LAD capacity to dewater Hertzler Ranch LAD storage pond
number of days to dewater Hertzler Ranch LAD storage pond at (24 hr) rate	**71** days	491 mg/L	median concentration of west side adit water and Hertzler Ranch LAD Storage Pond

This hydraulic load can be disposed of at the Hertzler Ranch LAD.

Input parameters and assumptions for salts loading calculations at Hertzler Ranch LAD; all other parameters as above		**Disposal of 400 gpm adit water plus 100 MG of treated water in the LAD storage pond at Hertzler Ranch LAD area.**	
$\mathbf{Q_1}$=kiA, Ground Water available for mixing	628 ft^3/d		calculation per Rule 17.30.517(d)
$\mathbf{Q_2}$=kiA, Ground Water available for mixing	97,603 ft^3/d		calculation per Rule 17.30.517(d)
$\mathbf{Q_3}$=kiA, Ground Water available for mixing	185,845 ft^3/d		calculation per Rule 17.30.517(d)
$\mathbf{Q_4}$=kiA, Ground Water available for mixing	37 ft^3/d		calculation per Rule 17.30.517(d)
$\mathbf{Q_5}$=kiA, Ground Water available for mixing	199,346 ft^3/d		calculation per Rule 17.30.517(d)
concentration of TDS in ambient ground water at Hertzler, $\mathbf{C_A}$	150 mg/L	234 μmhos/cm	SMC operational monitoring data; EC calculated
concentration of TDS in Hertzler Tailings impoundment and impoundment liner leakage, $\mathbf{C_4}$	1,870 mg/L		SMC operational monitoring data
concentration of TDS in LAD discharge, $\mathbf{C_2}$, $\mathbf{C_3}$	701 mg/L		higher concentration due to evaporation of applied waters through high pressure nozzles
concentration of TDS in LAD storage pond liner leakage, $\mathbf{C_1}$	491 mg/L		weighted concentration of LAD pond waters
volume upper LAD Discharge; P1, P2, P3; **assume 30% evaporates** $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm (12 hr)	application rate for upper LAD area, pers. comm. R. Weimer 2009
volume of Hertzler tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	33,690 ft^3/d	Pivot P1; 350 gpm application rate (12 hr), pers. comm. R. Weimer 2009
volume of LAD Storage Pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	38,503 ft^3/d	Pivot P2: 400 gpm application rate (12 hr), pers. comm. R. Weimer 2009
volume lower LAD discharge: P4, P5, P6 **assume 30% evaporates,** $\mathbf{V_3}$	77,487 ft^3/d	81,818 ft^3/d	Pivot P3; 850 gpm application rate (12 hr), pers. comm. R. Weimer 2009
total load of salt disposed at Hertzler during closure (400 gpm adit + 100 MG Hertzler LAD pond) for 71 days	**576,827 pounds**	43,316 ft^3/d	Pivots P4, P5; 450 gpm application rate (12 hr), pers. comm. R. Weimer 2009
		24,064 ft^3/d	Pivot P6; 250 gpm application rate (12 hr), pers. comm. R. Weimer 2009

Ground Water salts concentrations at Hertzler Ranch		**Disposal of 400 gpm of treated west side adit water and 100 MG of stored treated adit water at the Hertzler Ranch LAD area.**	
Ground Water concentration area Z_1 (below presumed Hertzler Ranch LAD storage pond liner leak), $\mathbf{C_1}$	230 mg/L	359 μmhos/cm	TDS concentration for Ground Water zone Z_1; EC calculated
Ground Water concentration area Z_2 (below upper Hertzler Ranch LAD), $\mathbf{C_2}$	439 mg/L	685 μmhos/cm	TDS concentration for Ground Water zone Z_2; EC calculated
Ground Water concentration area Z_4 (below presumed Hertzler Ranch tailings impoundment liner leak), $\mathbf{C_4}$	1,593 mg/L	2,484 μmhos/cm	TDS concentration for Ground Water zone Z_4; EC calculated
Ground Water EC in Z_3 (HMW-10) downgradient of all sources, C_3	368 mg/L	**575** μmhos/cm	TDS concentration and EC for Ground Water zone Z_3 at compliance point HMW-10
concentration in ground water at Z_5 down gradient of all sources (Z_1, Z_2, Z_3, Z_4), $\mathbf{C_5}$	303 mg/L	473 μmhos/cm	TDS concentration in ground water just prior to discharge to Stillwater River; EC calculated

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The EC of ground water at Hertzler Ranch LAD meets the Class I Beneficial Use criterion of 1,000 µmhos/cm.

Stillwater River TDS concentration below Hertzler Ranch LAD		**Disposal of 400 gpm of treated west side adit water and 100 MG of stored treated adit water at the Hertzler Ranch LAD area.**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream median ambient concentration SMC-12, C_s	44 mg/L	69 µmhos/cm	1995-2008 SMC Monitoring Data median TDS at SMC-12
ground water discharge volume, Q_d	669,139 ft^3/d	7.7 cfs	from mine site 2008 MPDES permit mixing zones
discharge concentration to Stillwater River, C_d	303 mg/L	473 µmhos/cm	TDS concentration in ground water just prior to discharge to Stillwater River
Stillwater River TDS concentration below Hertzler Ranch LAD	**96 mg/L**	149 µmhos/cm	assumes no treatment credit for salts

The TDS concentration in the Stillwater River below Hertzler Ranch LAD is less than the 250 mg/L recommendation protective of trout eggs.

Ground water concentration at Stillwater Mine		**Disposal of 250 gpm untreated east side adit water to the Stillwater Mine east side percolation ponds.**	
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d	48,128 ft^3/d	east side adit flow rate
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d	250 gpm (24 hr)	east side adit flow rate
1986-2008 MW-10A median concentration of TDS in ambient ground water Stillwater Mine, C_A	81 mg/L	126 µmhos/cm	concentration of salt in ambient ground water
ground water discharge volume, Q_d	79,660 ft^3/d	250 mg/L	concentration of salt in east side adit water
ground water TDS concentration at end of Stillwater east side percolation pond mixing zone	183 mg/L	**286** µmhos/cm	There is a potential for some salts load from the east side waste rock dump; no data has been collected to estimate the salts load.
ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	112 mg/L	**174** µmhos/cm	concentration of ground water just prior to discharge to Stillwater River near MW-17A

The EC of ground water at the Stillwater Mine meets the Class I Beneficial Use criterion of 1,000 µmhos/cm.

Stillwater River TDS concentration where ground water discharges to the Stillwater River at the Mine below the East side percolation ponds		**Disposal of 250 gpm untreated east side adit water to the Stillwater Mine east side percolation ponds.**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	45 mg/L	70 µmhos/cm	2008 MPDES Statement of Basis, p 9
ground water discharge volume, Q_d	265,648 ft^3/d	3.1 cfs	from mine site 2008 MPDES permit mixing zones
ground water discharge concentration to Stillwater River, C_d	112 mg/L	174 µmhos/cm	median Stillwater TDS adit water concentration, SMC Monitoring Data
Stillwater River TDS concentration at Stillwater Mine	**51 mg/L**	80 µmhos/cm	assumes no credit; uses mine site MPDES permit mixing zones for percolation ponds

The TDS concentration in the Stillwater River below the Stillwater Mine is less than the 250 mg/L recommendation protective of trout eggs.

POST CLOSURE salts concentrations in surface and ground water at Stillwater Mine, 2,020 gpm adit water disposal

2,020 gpm adit water disposal: West side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 378 mg/L TDS based upon the decline of salts in east-side adit water. East-side adit water quality is projected to be 155 mg/L. Analysis assumes all adit water is percolated at the East Side and Stillwater Valley Ranch percolation ponds or discharged directly to the Stillwater River

post closure TDS concentration of untreated west side adit water, C_{WPC}	**378** mg/L	155 mg/L	projected post closure TDS concentration of untreated east side adit water, C_{EPC}
post closure west side adit flow rate	**1,770** gpm (24 hr)	**250** gpm (24 hr)	post closure east side adit flow rate
1,000 gpm flow rate in cubic feet per day	192,513 ft^3/d	48,128 ft^3/d	post closure east side adit flow rate in cubic feet per day
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995

hydraulic conductivity east side percolation ponds, $\mathbf{k_{SVR}}$	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, $\mathbf{k_E}$	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, $\mathbf{L_{SVR}}$	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, $\mathbf{W_{SVR}}$	507 ft		2008 MPDES Permit page 3
length of mixing zone, $\mathbf{L_E}$	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, $\mathbf{W_E}$	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, $\mathbf{A_{SVR}}$	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_E}$	9,750 ft		D * W, allowed by 17.30.517(d)
$\mathbf{Q_{SVR}=k_{SVR}iA_{SVR}}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
$\mathbf{Q_E=k_EiA_E}$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
POST CLOSURE salts concentration in ground water at Stillwater Mine			**Disposal of 2,020 gpm untreated east and west side adit waters to the Stillwater Mine percolation ponds.**
1986-2008 MW-10A median concentration of TDS in ambient ground water at Stillwater Mine, $\mathbf{C_A}$	81 mg/L	126 µmhos/cm	
ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	290 mg/L	**452** µmhos/cm	discharge includes 250 gpm untreated east side adit water plus 770 gpm untreated west side adit water
POST CLOSURE ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	214 mg/L	**333** µmhos/cm	cumulative discharge to the Stillwater River includes 1,000 gpm percolated into east side ponds plus 1,020 gpm untreated west side adit water percolated at the Stillwater Valley Ranch Ponds; projected concentrations just prior to discharge to the Stillwater River
POST CLOSURE EC of ground water just prior to discharge to the Stillwater River if 1,770 gpm untreated west side adit water were percolated at the Stillwater Mine; meets Class I Beneficial Use criterion			
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, $\mathbf{C_s}$	45 mg/L	70 µmhos/cm	2008 MPDES Statement of Basis, p 9
ground water discharge volume, $\mathbf{Q_d}$	606,396 ft^3/d	4.6 cfs	
discharge concentration to Stillwater River, $\mathbf{C_d}$	214 mg/L		
POST CLOSURE Stillwater River TDS concentration at Stillwater Mine from PERCOLATION of 1,770 gpm untreated adit water	**76** mg/L		**projected TDS concentration in the Stillwater River if 2,020 gpm untreated west side adit water were percolated at the Stillwater Mine**
If 2,020 gpm untreated west side adit water were percolated at the Stillwater Mine, the concentration of TDS in the Stillwater River would not exceed the 250 mg/L guideline protective of trout eggs.			
POST CLOSURE Stillwater River TDS concentration at Stillwater Mine from DIRECT DISCHARGE of 1,770 gpm untreated adit water	**84** mg/L		**projected concentration in the Stillwater River if 2,020 gpm untreated west side adit water were DIRECTLY DISCHARGED INTO the Stillwater River**
If 2,020 gpm untreated west side adit water were directly discharged into the Stillwater River at the Stillwater Mine, the concentration of TDS in the Stillwater River would not exceed the 250 mg/L guideline protective of trout eggs.			

POST CLOSURE salts concentrations in surface and ground water at Stillwater Mine, 650 gpm adit water disposal

650 gpm adit water disposal: West side adit water quality at the beginning of post-closure (assumed to be one year in the analysis) is anticipated to be 378 mg/L TDS. East side adit water quality is assumed to be 250 mg/L. Analysis assumes all adit water is percolated at the East Side and Stillwater Valley Ranch percolation ponds or discharged directly to the Stillwater River.

post closure TDS concentration of untreated west side adit water, $\mathbf{C_{WPC}}$	**378** mg/L	155 mg/L	post closure TDS concentration of untreated east side adit water, $\mathbf{C_{EPC}}$
post closure west side adit flow rate	**400** gpm (24 hr)	**250** gpm (24 hr)	post closure east side adit flow rate

post closure west side adit flow rate	77,005 ft^3/d	48,128 ft^3/d	post closure east side adit flow rate
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, k_{SVR}	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, k_E	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, L_{SVR}	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, W_{SVR}	507 ft		2008 MPDES Permit page 3
length of mixing zone, L_E	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, W_E	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, A_{SVR}	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_E	9,750 ft		D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d); from mine site 2008 MPDES permit mixing zones
POST CLOSURE EC in ground water at Stillwater Mine		**projected EC in ground water at Stillwater Mine if 650 gpm untreated adit water were PERCOLATED at the east side percolation ponds**	
1986-2008 MW-10A median concentration of TDS in ambient ground water at Stillwater Mine, C_A	81 mg/L	126 µmhos/cm	
ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	250 mg/L	**390** µmhos/cm	
POST CLOSURE ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone (Stillwater Mine)	158 mg/L	**247** µmhos/cm	
POST CLOSURE EC of ground water just prior to discharge to the Stillwater River if 650 gpm untreated west side adit water were percolated at the Stillwater Mine; meets Class I Beneficial Use criterion			
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	45 mg/L	70 µmhos/cm	2008 MPDES Statement of Basis, p 9
ground water discharge volume, Q_d	342,653 ft^3/d	4.0 cfs	
discharge concentration to Stillwater River, C_d	158 mg/L		
POST CLOSURE Stillwater River TDS concentration at Stillwater Mine from PERCOLATION of 650 gpm untreated adit water	**58** mg/L	**projected concentration in the Stillwater River if 650 gpm untreated west side adit water were PERCOLATED at the Stillwater Mine**	
If 650 gpm untreated west side adit water were percolated at the Stillwater Mine, the concentration of TDS in the Stillwater River would not exceed the 250 mg/L recommendation protective of trout eggs.			
POST CLOSURE Stillwater River TDS concentration at Stillwater Mine from DIRECT DISCHARGE of 650 gpm untreated adit water	**56** mg/L	**projected concentration in the Stillwater River if 650 gpm untreated west side adit water were DIRECTLY DISCHARGED INTO the Stillwater River**	
If 650 gpm untreated west side adit water were DIRECTLY DISCHARGED into the Stillwater River at the Stillwater Mine, the concentration of TDS in the Stillwater River would not exceed the 250 mg/L recommendation protective of trout eggs.			

Spreadsheet 2A Nitrogen--Proposed Action Alternative 2A Stillwater Mine and Hertzler Ranch LAD Closure Nitrogen Analyses

For these analyses, the calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer; that is, no unsaturated zone was considered to determine concentrations of nitrogen in ground water. To determine the total nitrogen concentration in ground water at Hertzler Ranch the agencies assume that there is a leak in the Hertzler Ranch LAD Storage Pond liner in ground water zone Z1; the upper LAD discharges to ground water zone Z_2; the agencies assume there there is a leak from the Hertzler Ranch tailings impoundment in ground water zone Z_4; Zones Z_1, Z_2, and Z_4 flow into Z_3 where the lower LAD is discharged, then Z_3 flows into Z_5 (see Hertzler Ground Water Zone Figure). Treated adit water is routed to the Hertzler Ranch at closure until 100 lbs/day MPDES nitrogen limit can be met at the Stillwater Mine. Water routed to Hertzler Ranch would first be routed to the LAD storage pond then to LAD pivots during closure. These calculations assume the existing storage pond at closure would be 100 MG (accumulated over the winter season). The concentration of treated adit water will vary with flow rate.

Proposed Alternative 2A Option 1, 2,020 gpm: The 250 gpm of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds. Up to 250 gpm Stillwater tailings waters would be mixed and treated with 1,770 gpm west side adit water and routed to the Hertzler Ranch LAD storage pond for disposal with 521 gpm of untreated Hertzler Ranch tailings waters.

		50 pound/day	historical maximum combined discharged TN load from Stillwater Mine after BTS treatment
		1,770 gpm (24 hr)	west side adit flow rate at closure routed to Hertzler Ranch
time to dewater Stillwater tailings impoundment at given rate	97 days	250 gpm (24 hr)	Stillwater tailings flow rate at closure; fixed by pumping rate and BTS capacity at 2,020 gpm
Number of acres available for land application at Hertzler Ranch LAD	264 ac	2.4 mg/L	treated concentration of adit waters based on historical max TN load
operational application rate used at Hertzler Ranch achieving 80% TN removal efficiency SMC monitoring data	10.4 gpm/ac	3.3 mg/L	weighted concentration of mixed treated west side adit water plus treated Stillwater tailings waters
treated Stillwater tailings water TN concentration based on 80% BTS treatment efficiency	10 mg/L	50 mg/L	TN concentration of Stillwater and Hertzler Ranch tailings impoundments waters
concentration of Hertzler Ranch LAD storage pond prior to dewatering	2.4 mg/L	17.1 mg/L	weighted concentration of mixed Hertzler Ranch LAD storage pond water plus untreated Hertzler

Input Parameters for Hertzler Ranch Ground Water Calculations		**Source of Data**
depth of aquifer, **D**	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, $\mathbf{k_1}$ from LAD storage pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_4}$ from tailings impoundment	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis Hydrometrics 2003
width of source (Hertzler Ranch LAD storage pond liner leakage)	10 ft	assumed width based on point seep, Hydrometrics 2003
width of LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft	width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°	allowed by 17.30.517(d)
length of LAD storage pond liner leakage area, $\mathbf{L_1}$	1,800 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map
length upper LAD, $\mathbf{L_2}$	4,800 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of upper LAD at pivot P3	1,749 ft	personal communication R Weimer 3/17/2009
width of Upper LAD mixing zone $\mathbf{W_2}$	2,169 ft	width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of lower LAD, $\mathbf{L_3}$	5,200 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Lower LAD at pivot P4	1,610 ft	personal communication R Weimer 3/17/2009
Width of Lower LAD mixing zone $\mathbf{W_3}$	2,065 ft	personal communication R Weimer 2/18/2009
width of source (Hertzler Ranch tailings impoundment liner leakage)	10 ft	assumed width based on point seep, Hydrometrics 2003

width of mixing zone below Hertzler Ranch tailings impoundment liner leakage **W_4**	124 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of W_4 zone, **L_4**	1,300 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Mixing Zone to Stillwater River **W_5**	2,215 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length below lower LAD, **L_5**	3,600 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width below lower LAD	1,900 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
cross sectional area of aquifer, **A_1**	2,510 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, **A_2**	32,529 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, **A_3**	30,969 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, **A_4**	1,855 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, **A_5**	33,221 ft^2		D * W, allowed by 17.30.517(d)
Q_1 $=k_1iA_1$, ground water available for mixing	628 ft^3/d		calculation per 17.30.517(d)
Q_2 $=k_2iA_2$**,** ground water available for mixing	97,588 ft^3/d		calculation per 17.30.517(d)
Q_3 $=k_2iA_2$**,** ground water available for mixing	185,813 ft^3/d		calculation per 17.30.517(d)
Q_4 $=k_2iA_2$**,** ground water available for mixing	37 ft^3/d		calculation per 17.30.517(d)
Q_5 $=k_2iA_2$**,** ground water available for mixing	199,325 ft^3/d		calculation per 17.30.517(d)
Hydraulic Loading to Hertzler Ranch LAD		100 MG	Hertzler Ranch LAD Storage Pond volume
Stillwater tailings impoundment waters volume	35 MG	45 MG	Hertzler Ranch tailings impoundment waters volume
rate to dewater **Stillwater tailings impoundment** based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)	250 gpm (24 hr)	500 gpm (12 hr)	rate to dewater Stillwater tailings impoundment based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)
rate to dewater **Hertzler Ranch tailings impoundment** in 120 days (routed to Hertzler Ranch LAD storage pond)	260 gpm (24 hr)	521 gpm (12 hr)	rate to dewater Hertzler Ranch tailings impoundment in 120 days
rate to dewater **Hertzler Ranch LAD storage pond** in 120 days	579 gpm (24 hr)	1,157 gpm (12 hr)	rate to dewater **Hertzler Ranch LAD storage pond** in 120 days
adit flow rate at closure	**1,770** gpm (24 hr)	3,540 gpm (12 hr)	**adit** flow rate at closure
operational application rate used at Hertzler Ranch achieving 80% TN removal efficiency SMC monitoring data	**1,375** gpm (24 hr)	**2,750** gpm (12 hr)	operational application rate used at Hertzler Ranch achieving 80% TN removal efficiency SMC monitoring data
total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)	**2,859** gpm (24 hr)	**5,718** gpm (12 hr)	total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)
total volume of water needing disposal over 120 days	**486** MG	**238** MG	volume that can be LAD at maximum rate for 120 days

To dispose of the hydraulic load of 2,020 gpm adit water that could be generated at closure, other options would have to be implemented such as disposing of some of the treated waters at the Stillwater Mine percolation ponds or extending the time frame for closure.

Proposed Alternative 2A Option 2, 2,020 gpm- The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. Up to 250 gpm Stillwater tailings waters would be mixed and treated with 1,770 gpm west side adit water and routed to the Stillwater Mine percolation ponds. Up to 45 MG of untreated Hertzler Ranch tailings waters would be routed to the LAD storage pond containing 100 MG of treated adit water for disposal at the Hertzler Ranch LAD area.

total volume of water needing disposal at Hertzler Ranch over 120 days	**145** MG	**238** MG	volume that can be LAD at Hertzler Ranch at maximum rate for 120 days

The hydraulic load for Option 2 of 45 MG Hertzler Ranch tailings impoundment and 100 MG Hertzler Ranch LAD storage pond waters can be managed at Hertzler Ranch during one LAD season.

Appendix C
DEQ 2010

Total Nitrogen loading at Stillwater Mine		all 2,020 gpm adit and 250 gpm Stillwater tailings waters are disposed at the Stillwater Mine percolation ponds	
flow rate of **east side adit** water (pers. Comm. R. Weimer 2/18/2009)	250 gpm (24 hr)	192,513 ft^3/d	1,000 gpm in cubic feet per day (to calculate west side adit flow rate at closure)
east side adit water **Total Nitrogen concentration**	0.2 mg/L	2.4 mg/L	concentration of **LAD storage pond** prior to tailings waters mixing
contribution of **east side adit water** to Stillwater River total nitrogen load at Stillwater Mine	0.6 lbs/day	3.3 mg/L	weighted concentration of **mixed treated west side adit water plus treated Stillwater tailings waters**
contribution of Stillwater **waste rock dumps** total nitrogen load from percolating precipitation (1998 Hertzler Ranch EIS	11 lbs/day	250 gpm	**east side adit** flow rate at closure
historic average **west side adit water** total nitrogen load (based on SMC operational data since commissioning of BTS)	50 lbs/day	250 gpm	Stillwater tailings waters pumping rate at closure
Stillwater tailings water load based on BTS 80% total nitrogen removal efficiency	30 lbs/day	48,128 ft^3/d	250 gpm in cubic feet per day (both Stillwater tailings waters and east side adit water at closure)
daily total nitrogen load discharged at Stillwater Mine during closure	**92** lbs/day	**1,770** gpm	west side adit flow rate at closure

This load of total nitrogen at Stillwater Mine complies with the MPDES permit limit of 100 lbs/day.

Ground Water total nitrogen Calculation Input Parameters for the Stillwater Mine		these calculations have been made to evaluate ground water concentrations within the mixing zone when the total nitrogen load approaches the maximum MPDES permit total nitrogen limit (92 of the permitted 100 lbs/day)
depth of aquifer, **D**	15 ft	Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, $\mathbf{k_{SVR}}$	4076 ft/day	SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, $\mathbf{k_E}$	539 ft/day	SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft	Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, $\mathbf{L_{SVR}}$	500 ft	2008 MPDES Permit page 3
width of mixing zone at downgradient extent, $\mathbf{W_{SVR}}$	507 ft	2008 MPDES Permit page 3
length of mixing zone, $\mathbf{L_E}$	2,000 ft	2008 MPDES Permit page 4
width of mixing zone at downgradient extent, $\mathbf{W_E}$	650 ft	2008 MPDES Permit page 4
cross sectional area of aquifer, $\mathbf{A_{SVR}}$	7,605 ft	D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_E}$	9,750 ft	D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d	calculation per 17.30.517(d)
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d	calculation per 17.30.517(d)
median ambient TN concentration in ground water at MW-10A Stillwater Mine, $\mathbf{C_A}$	0.1 mg/L	projected average concentration of TN in ambient ground water at SMC MW-10A
projected ground water total nitrogen concentration at end of Stillwater East Side Percolation Pond mixing zone	**2.4** mg/L	average concentration of total nitrogen from percolation of 770 gpm west side adit waters plus treated Stillwater tailings waters plus east side adit waters
projected ground water total nitrogen concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone	**2.0** mg/L	cumulative concentration of total nitrogen from Stillwater East Side percolation plus percolation of 1000 gpm west side adit waters at Stillwater Valley Ranch

The concentration of total nitrogen at the edge of the mixing zone meets the DEQ-7 ground water criterion of 10 mg/L.

Stillwater River TN concentration below Stillwater Mine			**these calculations have been made to evaluate ground water concentrations within the mixing zone when the total nitrogen load approaches the maximum MPDES permit total nitrogen limit (92 of the permitted 100 lbs/day)**
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream total nitrogen ambient concentration, $\mathbf{C_s}$	0.3 mg/L		median ambient total nitrogen concentration at SMC-1A 1986-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient total inorganic nitrogen concentration is 0.06 mg/L
ground water discharge volume, $\mathbf{Q_d}$	654,525 ft^3/d	7.6 cfs	ground water discharge to stream in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	2.0 mg/L		total nitrogen concentration of ground water just prior to discharge to Stillwater River
projected Stillwater River total nitrogen Concentration at Stillwater Mine	**0.6 mg/L**		

The concentration of total nitrogen in the Stillwater River at the Stillwater Mine is less than the 1 mg/L MPDES surface water criterion. At a Nitrogen load of 92 lbs/day this option approaches the maximum discharge to ground and surface water. The resulting concentrations are well below the DEQ-7 ground water criterion of 10 mg/L and the MPDES 1 mg/L surface water criterion. No further ground water or surface water concentration calculations will be made if the discharge meets the MPDES load limits.

Input parameters and assumptions for Total Nitrogen calculations at Hertzler Ranch			**Land application disposal of 45 MG of Hertzler Ranch Tailings impoundment waters and 100 MG of Hertzler Ranch LAD storage pond waters**
Total Nitrogen concentration in ambient ground water (HMW-4 SMC Monitoring Data), $\mathbf{C_A}$	0.2 mg/L		
concentration of Total Nitrogen in Hertlzer Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	17.1 mg/L	109 days	time to LAD 145 MG using full rate of pivot P6 (250 gpm) with Upper LAD
concentration of Total Nitrogen in upper and lower LAD discharge, post plant uptake (80% credit), $\mathbf{C_2}$, $\mathbf{C_3}$	3.4 mg/L	**17.1** mg/L	weighted average concentration of mixed LAD storage pond water
Total Nitrogen concentration in Hertzler Ranch tailings impoundment liner leakage (equal to impoundment underdrain concentration), $\mathbf{C_4}$	4 mg/L	250 gpm (12 hr)	pivot P6 rate
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm (12 hr)	for 12 hour application rate (720 min/day) upper LAD
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	33,690 ft^3/d	pivot P1; 350 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	38,503 ft^3/d	pivot P2: 400 gpm for 12 hour application rate
volume lower LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	16,845 ft^3/d	81,818 ft^3/d	pivot P3; 850 gpm for 12 hour application rate
daily total nitrogen load to ground water at closure at Hertzler Ranch	**54** lbs/day	43,316 ft^3/d	pivots P4, P5; 450 gpm for 12 hour application rate
total total nitrogen load disposed at Hertzler Ranch during closure	**5,918** lbs	24,064 ft^3/d	pivot P6; 250 gpm for 12 hour application rate
		264 ac	area of LAD at Hertzler Ranch

Ground Water total nitrogen concentrations at Hertzler Ranch		**Land application disposal of 45 MG of Hertzler Ranch Tailings impoundment waters and 100 MG of Hertzler Ranch LAD storage pond waters**		
ground water nitrogen concentration area $\mathbf{Z_1}$	4.2 mg/L			loading calculation for Ground Water zone Z_1
ground water nitrogen concentration area $\mathbf{Z_2}$	1.9 mg/L			loading calculation for Ground Water zone Z_2
ground water nitrogen concentration area $\mathbf{Z_4}$	3.4 mg/L			loading calculation for Ground Water zone Z_4
projected ground water Total Nitrogen concentration in $\mathbf{Z_3}$ from Z_1, Z_2, Z_3, Z_4, $\mathbf{C_d}$	**1.2 mg/L**			concentration at compliance point HMW-10 (1992 Hertzler Ranch EIS)
ground water Total Nitrogen concentration in $\mathbf{Z_5}$ from upgradient sources (Z_1, Z_2, Z_3, Z_4)	0.9 mg/L			projected ground water concentration prior to discharge to Stillwater River
The total nitrogen concentration in ground water at Hertzler Ranch meets the DEQ-7 ground water criterion of 10 mg/L.				
Stillwater River TN concentration below Hertzler Ranch		**Land application disposal of 45 MG of Hertzler Ranch Tailings impoundment waters and 100 MG of Hertzler Ranch LAD storage pond waters**		
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs		7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.35 mg/L			median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN concentration is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	591,395 ft^3/d	6.8 cfs		ground water discharge to stream in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	0.9 mg/L			
projected Stillwater River nitrogen concentration below Hertzler Ranch	**0.4 mg/L**			
The total nitrogen concentration in the Stillwater River below Hertzler Ranch is less than 1.0 mg/L.				
Proposed Alternative 2A Option 1, 650 gpm - The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. The 400 gpm west side adit water would be mixed and treated with 600 gpm Stillwater tailings water and routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. All these waters would be routed for disposal at the Hertzler Ranch LAD area over a 142 day extended LAD season.				
Total Nitrogen loading at Stillwater Mine		**250 gpm untreated east side adit waters disposed of at the Stillwater Mine percolation ponds**		
volume of east side adit water--percolated at east side percolation ponds	48,128 ft^3/d	250 gpm (24 hr)		east side adit flow rate; personal communication R Weimer 2/18/2009
east side adit water total nitrogen concentration	0.2 mg/L			SMC monitoring data
contribution of east side adit water to Stillwater River total nitrogen load at Stillwater Mine	0.6 lbs/day			
contribution of nitrogen from Stillwater waste rock dumps to the total nitrogen load due to precipitation percolating through dumps	11 lbs/day			1998 Hertzler Ranch EIS p 4-3
daily total nitrogen load discharged at Stillwater Mine Site during closure	**12** lbs/day			
This load of total nitrogen at Stillwater Mine complies with the MPDES total nitrogen permit limit of 100 pounds per day. No further analysis is required.				

Hydraulic Loading to Hertzler Ranch LAD		23 MG	volume of adit water days 1-41
Stillwater tailings impoundment waters volume	35 MG	58 MG	volume of adit water days 42-142
Hertzler Ranch tailings impoundment waters volume	45 MG	100 MG	Hertzler Ranch LAD Storage Pond volume
rate to dewater **Stillwater tailings impoundment** based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)	600 gpm (24 hr)	**1,200** gpm (12 hr)	rate to dewater Stillwater tailings impoundment based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)
time to dewater Stillwater tailings impoundment at given rate	41 days	142 days	length of extended LAD season
rate to dewater **Hertzler Ranch tailings impoundment** in 120 days (routed to Hertzler Ranch LAD storage pond)	260 gpm (24 hr)	**521** gpm (12 hr)	rate to dewater Hertzler Ranch tailings impoundment in 120 days
rate to dewater **Hertzler Ranch LAD storage pond** in 120 days	579 gpm (24 hr)	**1,157** gpm (12 hr)	rate to dewater **Hertzler Ranch LAD storage pond** in 120 days
west side adit flow rate at closure	**400** gpm (24 hr)	**800** gpm (12 hr)	**west side adit** flow rate at closure
operational application rate used at Hertzler Ranch achieving 80% TN removal efficiency SMC monitoring data	1,375 gpm (24 hr)	2,750 gpm (12 hr)	operational application rate used at Hertzler Ranch achieving 80% TN removal efficiency SMC monitoring data
total rate of water needing disposal at closure (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD	**1,839** gpm (24 hr)	**3,678** gpm (12 hr)	total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)
total volume of water needing disposal at closure	**262** MG	**281** MG	volume that can be LAD at maximum rate for extended LAD season
If the LAD season is extended to 142 days, the hydraulic load of 450 gpm treated adit water plus 600 gpm treated Stillwater tailings waters, plus 45 MG untreated Hertzler tailings waters and 100 MG Hertzler Ranch LAD storage pond waters can be managed at Hertzler Ranch LAD.			
Total Nitrogen loading at Hertzler Ranch LAD		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
treated concentration of west side adit waters based on historical maximum total nitrogen load treatment	10.4 mg/L	50 lbs/day	historical maximum BTS load discharged from Stillwater Mine
treated Stillwater tailings water total nitrogen concentration based on 80% BTS treatment efficiency	10 mg/L	50 mg/L	Hertzler Ranch tailings impoundment waters concentration
weighted total nitrogen concentration of treated adit plus Stillwater tailings waters (41 days)	10.2 mg/L	19.1 mg/L	Total Nitrogen concentration of mixed Hertzler Ranch LAD storage pond water **up through day 41**
volume of water LAD **days 1-41**	80 MG	16.3 mg/L	Total Nitrogen concentration of mixed Hertzler Ranch LAD storage pond water **day 42 through 142**
volume upper LAD Discharge; P1, P2, P3; no evaporation, $\mathbf{V_2}$	154,011 ft^3/d	1,600 gpm (12 hr)	Upper LAD discharge, pivots P1, P2, P3
volume lower LAD Discharge; P4, P5, P6; no evaporation, $\mathbf{V_3}$	110,695 ft^3/d	1,150 gpm (12 hr)	Lower LAD discharge, pivots P4, P5, P6
daily load of Total Nitrogen to ground water days 1 - 41 at Hertzler Ranch	90 lbs/day	264 ac	area available at Hertzler Ranch, upper and lower LAD
daily load of Total Nitrogen to ground water days 42 -142 at Hertzler Ranch	77 lbs/day		
total Total Nitrogen load to ground water at Hertzler Ranch during closure	**11,451 lbs/yr**		

Input parameters and assumptions for Total Nitrogen calculations

Total Nitrogen concentration in ambient ground water (HMW-4 SMC Monitoring Data), $\mathbf{C_A}$	0.2 mg/L		SMC Monitoring Reports
Total Nitrogen concentration in Hertzler Ranch tailings Impoundment liner leakage (assume equal to underdrain concentration), $\mathbf{C_4}$	4 mg/L	1,600 gpm (12 hr)	upper LAD application rate (720 min/day)
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d	33,690 ft^3/d	pivot P1; 350 gpm for 12 hour application rate
weighted average Total Nitrogen concentration in LAD discharge, evaporation credit taken, post plant uptake (80% credit), $\mathbf{C_2}$, $\mathbf{C_3}$	2.4 mg/L	38,503 ft^3/d	pivot P2: 400 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	81,818 ft^3/d	pivot P3; 850 gpm for 12 hour application rate
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	1,150 gpm (12 hr)	total lower LAD application rate, pivots P4, P5, P6 at 720 min/day
weighted total nitrogen concentration in Hertzler Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	17.1 mg/L	43,316 ft^3/d	pivots P4, P5; 450 gpm for 12 hour application rate
volume lower LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487 ft^3/d	24,064 ft^3/d	pivot P6; 250 gpm for 12 hour application rate

Ground Water concentrations at Hertzler Ranch		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
ground water total nitrogen concentration area $\mathbf{Z_1}$	4.2 mg/L		loading calculation for Ground Water zone Z_1
ground water total nitrogen concentration area $\mathbf{Z_2}$	1.4 mg/L		loading calculation for Ground Water zone Z_2
ground water total nitrogen concentration area $\mathbf{Z_4}$	3.4 mg/L		loading calculation for Ground Water zone Z_4
projected ground water total nitrogen concentration in Z_3 (from Z_1, Z_2, Z_3, Z_4), $\mathbf{C_d}$	**1.1 mg/L**		cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
ground water total nitrogen concentration in $\mathbf{Z_5}$ from upgradient sources (Z_1, Z_2, Z_3, Z_4)	0.8 mg/L		projected ground water concentration prior to discharge to Stillwater River

The total nitrogen concentration in ground water below Hertzler Ranch meets the DEQ-7 ground water criterion of 10 mg/L.

Stillwater River concentration below Hertzler Ranch		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.35 mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN concentration is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	669,071 ft^3/d	7.7 cfs	ground water discharge to stream in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	0.8 mg/L		
projected Stillwater River concentration below Hertzler Ranch LAD	**0.4 mg/L**		the actual concentration at SMC-13 would be less due to higher streamflow

The total nitrogen concentration in the Stillwater River below Hertzler Ranch is less than 1.0 mg/L.

Proposed Alternative 2A Option 2, 650 gpm - The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. The 400 gpm west side adit water would be mixed and treated with 600 gpm Stillwater tailings water and 716 gpm of that flow would be routed to the east percolation ponds for disposal. The other 284 gpm would be routed to the Hertzler Ranch LAD storage pond with up to 45 MG of untreated Hertzler Ranch tailings waters. The Hertzler Ranch LAD storage pond would contain 100 MG of treated adit water for disposal at the Hertzler Ranch LAD area.

Total Nitrogen Loading to Stillwater Mine Percolation Ponds		**716 gpm treated mixed west side adit waters plus Stillwater tailings waters plus 250 gpm untreated east side adit water percolated at Stillwater Mine**	
total nitrogen Loading to Stillwater Mine Percolation Ponds	87 pound/day	716 gpm (24 hr)	rate of mixed treated west side adit and Stillwater tailings waters percolated at Stillwater Mine ponds
contribution of east side adit water to Stillwater River total nitrogen load at Stillwater Mine	0.6 pounds/day	**10.2** mg/L	weighted total nitrogen concentration of mixed west side adit and Stillwater tailings waters
contribution of nitrogen from Stillwater waste rock dumps to the total nitrogen load due to precipitation percolating through dumps	11 pounds/day		Hertzler Ranch EIS 1998 page 4-3
daily Total Nitrogen load discharged to ground water at Stillwater Mine Site during closure	**99** pound/day		
This load of total nitrogen at Stillwater Mine complies with the MPDES total nitrogen permit limit of 100 pounds per day. No further analysis is required.			
Hydraulic Loading to Hertzler Ranch LAD		**284 gpm treated mixed west side adit waters plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond with untreated Hertzler Ranch tailings waters**	
rate treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond	284 gpm (24 hr)	24 MG	volume of adit water days 1-41
Stillwater tailings impoundment waters volume routed to Hertzler Ranch	17 MG	46 MG	volume of adit water days 42-142
Hertzler Ranch tailings impoundment waters volume	45 MG	100 MG	Hertzler Ranch LAD Storage Pond volume
rate to dewater **Stillwater tailings impoundment** based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)	600 gpm (24 hr)	**1,200** gpm (12 hr)	rate to dewater Stillwater tailings impoundment based on available BTS capacity (routed to Hertzler Ranch LAD storage pond)
time to dewater Stillwater tailings impoundment at given rate	41 days	120 days	length of LAD season
rate to dewater **Hertzler Ranch tailings impoundment** in 120 days (routed to Hertzler Ranch LAD storage pond)	260 gpm (24 hr)	**521** gpm (12 hr)	rate to dewater Hertzler Ranch tailings impoundment in 120 days
rate to dewater **Hertzler Ranch LAD storage pond** in 120 days	579 gpm (24 hr)	**1,157** gpm (12 hr)	rate to dewater **Hertzler Ranch LAD storage pond** in 120 days
west side adit flow rate at closure	**400** gpm (24 hr)	**800** gpm (12 hr)	**west side adit** flow rate at closure
operational application rate used at Hertzler Ranch achieving 80% nitrogen removal efficiency SMC monitoring data	1,375 gpm (24 hr)	2,750 gpm (12 hr)	operational application rate used at Hertzler Ranch achieving 80% nitrogen removal efficiency SMC monitoring data
total rate of water needing disposal at closure (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)	**1,839** gpm (24 hr)	**3,678** gpm (12 hr)	total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)
total volume of water needing disposal at closure	**231** MG	**238** MG	volume that can be LAD during season

If the LAD season is extended to 142 days, the hydraulic load of 450 gpm treated adit water plus 600 gpm treated Stillwater tailings waters, plus 45 MG untreated Hertzler tailings waters and 100 MG Hertzler Ranch LAD storage pond waters can be managed at the Hertzler Ranch LAD area.

Appendix C
DEQ 2010

Input parameters and assumptions for Total Nitrogen calculations			284 gpm treated mixed west side adit waters plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond with untreated Hertzler Ranch tailings waters	
concentration of Total Nitrogen in ambient ground water at HMW-4, $\mathbf{C_A}$		0.2 mg/L	**18.1** mg/L	weighted average Total Nitrogen concentration of mixed LAD storage pond waters
concentration of Total Nitrogen in Hertzler Ranch tailings Impoundment liner leakage, $\mathbf{C_4}$		4 mg/L	1,600 gpm (12 hr)	total upper LAD application rate, pivots P1, P2, P3 at 720 min/day
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$		107,807 ft^3/d	33,690 ft^3/d	pivot P1; 350 gpm for 12 hour application rate
concentration of Total Nitrogen in LAD discharge, evaporation credit taken, post plant uptake (80% credit), $\mathbf{C_2}$, $\mathbf{C_3}$		2.5 mg/L	38,503 ft^3/d	pivot P2: 400 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$		193 ft^3/d	81,818 ft^3/d	pivot P3; 850 gpm for 12 hour application rate
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$		193 ft^3/d	1,150 gpm (12 hr)	total lower LAD application rate, pivots P4, P5, P6 at 720 min/day
concentration of Total Nitrogen in Hertzler Ranch LAD storage pond liner leakage, $\mathbf{C_1}$		18.1 mg/L	43,316 ft^3/d	pivots P4, P5; 450 gpm for 12 hour application rate
volume lower LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$		77,487 ft^3/d	24,064 ft^3/d	pivot P6; 250 gpm for 12 hour application rate
Ground Water concentrations at Hertzler Ranch				
ground water total nitrogen concentration area Z_1	4.4	mg/L		loading calculation for Ground Water zone Z_1
ground water total nitrogen concentration area Z_2	1.4	mg/L		loading calculation for Ground Water zone Z_2
ground water total nitrogen concentration area Z_4	3.4	mg/L		loading calculation for Ground Water zone Z_4
projected ground water total nitrogen concentration in Z_3 from Z_1, Z_2, Z_3, Z_4, $\mathbf{C_d}$	**1.1**	**mg/L**		cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
ground water total nitrogen concentration in Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4)	0.9	mg/L		projected ground water concentration prior to discharge to Stillwater River

The total nitrogen concentration in ground water below Hertzler Ranch meets the DEQ-7 water quality criterion of 10 mg/L.

Stillwater River total nitrogen concentration below Hertzler Ranch			
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.35 mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient total inorganic nitrogen concentration is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	669,071 ft^3/d	7.7 cfs	ground water discharge to stream in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	0.9 mg/L		projected ground water concentration prior to discharge to Stillwater River
projected Stillwater River total nitrogen concentration below Hertzler Ranch	**0.4 mg/L**		

The total nitrogen concentration in the Stillwater River below Hertzler Ranch is less than 1.0 mg/L.

Spreadsheet 2A Salts--Alternative 2A Proposed Action Stillwater Mine and Hertzler Ranch Salinity Analyses

For Hertzler Ranch, the assumptions for calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer; that is, no unsaturated zone was considered to determine concentrations of salts in ground water. To determine the EC of ground water at Hertzler Ranch, the agencies assume that there is a leak in the Hertzler Ranch LAD Storage Pond liner in ground water zone Z_1; the upper LAD discharges to ground water zone Z_2; assume there is a leak from the Hertzler Ranch tailings impoundment in ground water zone Z_4; Z_1, Z_2, and Z_4 flow into Z_3 where the lower LAD is discharged, then Z_3 flows into Z_5 (see Hertzler Ground Water Zone Figure). Salts are not treated in the BTS or Hertzler Ranch LAD, so all salts are expected to eventually flush through the soil column and unsaturated zone to ground water. The agencies used the median adit water TDS concentration for the operational Stillwater Mine concentration. The Stillwater M Weighted concentrations of TDS or EC assume instantaneous mixing.

Proposed Alternative 2A Option 1, 2,020 gpm: The 250 gpm of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds. Up to 250 gpm Stillwater tailings waters would be mixed and treated with 1,770 gpm west side adit water and routed to the Hertzler Ranch LAD storage pond for disposal with 521 gpm of untreated Hertzler Ranch tailings waters.

		1,770	gpm (24 hr)	adit flow rate at closure
TDS conversion 1 mg/L = 1.56 µmhos/cm		**491**	mg/L	median Stillwater TDS west side adit water concentration, SMC Monitoring Data
		250	mg/L	average 2004-2008 Stillwater east side adit TDS concentration
Hertzler Ranch LAD area	264 ac	**1,870**	mg/L	concentration of TDS in tailings waters
time to dewater Stillwater tailings impoundment at given rate	97 days	**250**	gpm (24 hr)	Stillwater tailings flow rate at closure; (fixed by west side adit pumping rate plus BTS capacity)
		521	gpm (12 hr)	rate to dewater Hertzler Ranch Tailings Impoundment in 120 days
weighted EC of mixed **adit plus Stillwater tailings waters**	1032 µmhos/cm	**662**	mg/L	weighted TDS in mixed **adit plus Stillwater tailings waters** assume instantaneous mixing
weighted EC of mixed treated adit water in **Hertzler Ranch LAD storage pond with untreated Hertzler Ranch tailings waters**	1,434 µmhos/cm	**919**	mg/L	weighted TDS of mixed **Hertzler Ranch LAD storage pond water** (100MG treated adit water) **with untreated Hertzler Ranch tailings waters;** assume instantaneous mixing

Input Parameters for Hertzler Ranch Ground Water Calculations		**Source of Data**
depth of aquifer, **D**	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, $\mathbf{k_1}$ from Hertzler Ranch LAD storage pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper Hertzler Ranch LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower Hertzler Ranch LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_4}$ from tailings impoundment	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis
width of source (Hertzler Ranch LAD storage pond liner leakage)	10 ft	assumed width based on point seep, Hydrometrics 2003
width of Hertzler Ranch LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft	width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°	allowed by 17.30.517(d)
length Hertzler Ranch LAD storage pond liner leakage area, $\mathbf{L_1}$	1,800 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map
length upper Hertzler Ranch LAD, $\mathbf{L_2}$	4,800 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of upper Hertzler Ranch LAD at pivot P3	1,749 ft	personal communication R Weimer 2/18/2009
width of Upper Hertzler Ranch LAD mixing zone $\mathbf{W_2}$	2,169 ft	width of source + (tan 5 * length) allowed by 17.30.517(d)
length of lower Hertzler Ranch LAD, $\mathbf{L_3}$	5,200 ft	from Hertzler Tailings Impoundment Seepage Analysis 2003 map

width of Lower Hertzler Ranch LAD at P4	1,610 ft		personal communication R Weimer 2/18/2009
Width of Lower Hertzler Ranch LAD mixing zon**e** $\mathbf{W_3}$	2,065 ft		personal communication R Weimer 2/18/2009
Width of source (Hertzler Ranch tailings impoundment liner leakage)	10 ft		assumed width based on point seep, Hydrometrics 2003
width of mixing zone below Hertzler Ranch tailings impoundment liner leakage $\mathbf{W_4}$	124 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of W_4 zone, $\mathbf{L_4}$	1,300 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Mixing Zone to Stillwater River $\mathbf{W_5}$	2,215 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length below lower Hertzler Ranch LAD, $\mathbf{L_5}$	3,600 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width below lower Hertzler Ranch LAD	1,900 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
cross sectional area of aquifer, $\mathbf{A_1}$	2,510 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_2}$	32,529 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_3}$	30,969 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_4}$	1,855 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_5}$	33,221 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, ground water available for mixing	628 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_2}$=kiA, ground water available for mixing	97,588 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_3}$=kiA, ground water available for mixing	185,813 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_4}$=kiA, ground water available for mixing	37 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_5}$=kiA, ground water available for mixing	199,325 ft^3/d		calculation per 17.30.517(d)
Hydraulic Loading to Hertzler Ranch LAD		100 MG	Hertzler Ranch LAD Storage Pond volume
Stillwater tailings impoundment waters volume	35 MG	45 MG	Hertzler Ranch tailings impoundment waters volume
rate to dewater **Hertzler Ranch tailings** impoundment in 120 days (routed to Hertzler Ranch LAD storage pond)	260 gpm (24 hr)	**521** gpm (12 hr)	rate to dewater Hertzler Ranch Tailings Impoundment in 120 days (routed to Hertzler Ranch LAD storage pond)
rate to dewater **Hertzler Ranch LAD storage pond** in 120 days	579 gpm (24 hr)	**1,157** gpm (12 hr)	rate to dewater Hertzler Ranch LAD storage pond in 120 days
rate to dewater Stillwater tailings impoundment based on BTS capacity (routed to Hertzler Ranch LAD storage pond for 97 days)	250 gpm (24 hr)	**500** gpm (12 hr)	rate to dewater Stillwater tailings impoundment based on BTS capacity (routed to Hertzler Ranch LAD storage pond)
adit flow rate at closure	1,770 gpm (24 hr)	**3,540** gpm (12 hr)	**adit** flow rate at closure
maximum LAD rate from Hertzler Ranch LAD storage pond	**1,375** gpm (24 hr)	**2,750** gpm (12 hr)	maximum Hertzler Ranch LAD application rate
total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)	**2,859** gpm (24 hr)	**5,718** gpm (12 hr)	total rate of water needing disposal in 120 days (adit plus Stillwater tailings plus Hertzler tailings plus Hertzler LAD storage pond)
total volume of water needing disposal over 120 days	**306** MG	**238** MG	volume that can be LAD at maximum rate for 120 days

The hydraulic load for Option 1 of 1,770 gpm treated adit water plus 250 gpm treated Stillwater tailings waters plus 45 MG Hertzler Ranch tailings impoundment plus 100 MG Hertzler Ranch LAD storage pond waters cannot be managed at Hertzler Ranch during one LAD season. Other options would have to be implemented such as disposing of some of the treated waters at the Stillwater Mine percolation ponds or extending the time frame for closure.

Proposed Alternative 2A Option 2, 2,020 gpm- The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. Up to 250 gpm Stillwater tailings waters would be mixed and treated with 1,770 gpm west side adit water and routed to the Stillwater Mine percolation ponds. Up to 45 MG of untreated Hertzler Ranch tailings waters would be routed to the LAD storage pond containing 100 MG of treated adit water for disposal at the Hertzler Ranch LAD area.

total volume of water needing disposal over 120 days	**145** MG	**238** MG	volume that can be LAD at maximum rate for 120 days

The hydraulic load for Option 2 of 45 MG Hertzler Ranch tailings impoundment and 100 MG Hertzler Ranch LAD storage pond waters can be managed at Hertzler Ranch during one LAD season.

Input parameters and assumptions for salts calculations at Hertzler Ranch LAD		1,157 gpm (12 hr)	rate to dewater Hertzler LAD storage pond in 120 days
TDS in ambient ground water (HMW-4 SMC monitoring data), $\mathbf{C_A}$	150 mg/L	521 gpm (12 hr)	rate to dewater Hertzler Ranch Tailings Impoundment in 120 days (routed to Hertzler Ranch LAD storage pond)
TDS in Hertzler Ranch tailings impoundment liner leakage, $\mathbf{C_4}$	1,870 mg/L	**1,678** gpm (12 hr)	total rate of water needing disposal in 120 days (Hertzler LAD storage pond plus Hertzler Ranch tailings impoundment)
TDS in upper and lower Hertzler Ranch LAD discharge, evaporation taken, no credit for plant uptake, $\mathbf{C_2, C_3}$	1,314 mg/L	1600 gpm (12 hr)	rate that can be LAD at Hertzler Ranch **Upper LAD**
TDS in Hertzler Ranch LAD storage pond liner leakage (mixed adit plus Hertzler Ranch tailings waters), $\mathbf{C_1}$	919 mg/L	78 gpm (12 hr)	excess rate that must be LAD at Hertzler Ranch **Lower LAD**
volume upper Hertzler Ranch LAD Discharge, assumes 30% evaporates; pivots P1, P2, P3; $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm (12 hr)	application 720 min/day at **upper LAD**-- total for all areas is 2,750 gpm
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	33,690 ft^3/d	pivot P1; 350 gpm for 12 hour application rate CES 2008
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	38,503 ft^3/d	pivot P2: 400 gpm for 12 hour application rate CES 2008
volume lower Hertzler Ranch LAD discharge, assumes 30% evaporates: only pivot P6 needed to manage this option; $\mathbf{V_3}$	16,845 ft^3/d	81,818 ft^3/d	pivot P3; 850 gpm for 12 hour application rate CES 2008
daily load of TDS disposed at closure at Hertzler Ranch	**18,507** lb/day	43,316 ft^3/d	pivots P4, P5; 450 gpm for 12 hour application rate CES 2008
total load of TDS disposed at Hertzler Ranch during closure	**2,014,645** lb	24,064 ft^3/d	pivot P6; 250 gpm for 12 hour application rate CES 2008
annual TDS load per acre per year (264 ac)	**7,631** lb/ac/yr	**1,150** gpm (12 hr)	application 720 min/day at **lower LAD**-- total for all areas is 2,750 gpm
annual TDS load per square foot per year (264 ac)	**0.2** lb/ft^2/yr	109 days	time to LAD 145 MG using full rate of pivot P6 (250 gpm)
Ground water salts concentrations at Hertzler Ranch		**45 MG Hertzler Ranch tailings impoundment and 100 MG Hertzler Ranch LAD storage pond waters LAD at Hertzler Ranch during one LAD season**	
ground water concentration area $\mathbf{Z_1}$	331 mg/L	516 µmhos/cm	ground water EC for zone Z_1
ground water concentration area $\mathbf{Z_2}$	761 mg/L	**1,187** µmhos/cm	ground water EC for zone Z_2; **does not meet Class I Beneficial Use criterion**
ground water concentration area $\mathbf{Z_4}$	1,593 mg/L	**2,485** µmhos/cm	ground water EC for zone Z_4; **does not meet Class I Beneficial Use criterion**
ground water EC concentration in $\mathbf{Z_3}$ at compliance point HMW-10	506 mg/L	**789** µmhos/cm	projected ground water EC for zone Z_3 from Z_1, Z_2, Z_3, Z_4; compliance point HMW-10
EC concentration in $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1, Z_2, Z_3, Z_4}$)	389 mg/L	607 µmhos/cm	projected ground water concentration prior to discharge to Stillwater River

The EC of ground water below Hertzler Ranch LAD at the compliance point (HMW-10) just prior to discharge into the Stillwater River meets the Class I Beneficial Use criterion.

Stillwater River salts concentration below Hertzler Ranch		**45 MG Hertzler Ranch tailings impoundment and 100 MG Hertzler Ranch LAD storage pond waters LAD at Hertzler Ranch during one LAD season**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs 2008 MPDES; actual streamflow is greater
receiving stream ambient concentration, $\mathbf{C_s}$	44 mg/L	69 µmhos/cm	average concentration below Hertzler Ranch SMC-12; SMC Operational Monitoring Data
ground water discharge volume, $\mathbf{Q_d}$	608,429 ft^3/d	7.0 cfs	ground water discharge volume in cubic feet per second
ground water discharge concentration to Stillwater River, $\mathbf{C_d}$	389 mg/L	607 µmhos/cm	projected ground water concentration prior to discharge to Stillwater River
TDS Stillwater River concentration	**108 mg/L**	168 µmhos/cm	projected EC in Stillwater River at point of discharge

The TDS concentration in the Stillwater River near Hertzler Ranch is less than the 250 mg/L recommendation for protection of trout eggs.

TDS loading at Stillwater Mine			**250 gpm untreated east side adit waters, 1,770 gpm treated west side adit waters, and 250 gpm treated Stillwater tailings waters are disposed of at the Stillwater Mine percolation ponds**	
volume of east side adit water--percolated at east side perc ponds	48,128 ft^3/d		250 gpm (24 hr)	east side adit flow rate; personal communication R Weimer 2/18/2009
east side adit water TDS concentration	250 mg/L		48,128 ft^3/d	250 gpm flow in cubic feet per day (east side adit, Stillwater tailings waters, and pivot 6 rate)
contribution of east side adit water to Stillwater River TDS load at Stillwater Mine during closure (no treatment credit)	750 pounds/day		662 mg/L	weighted TDS in mixed **adit plus Stillwater tailings waters** assume instantaneous mixing
contribution of west side adit water to Stillwater River TDS load at Stillwater Mine during closure (no treatment credit)	14,054 pounds/day		1,770 gpm (24 hr)	adit flow rate at closure
contribution of Stillwater tailings impoundment water TDS load during closure (no treatment credit)	5,610 pounds/day		250 gpm (24 hr)	Stillwater tailings flow rate at closure; (fixed by west side adit pumping rate + BTS capacity)
daily TDS load discharged at Stillwater Mine during closure	**20,414**	pound/day	97 days	time to dewater the Stillwater tailings impoundment
total TDS load disposed at Stillwater Mine during closure	**1,984,678**	pound/year	192,513 ft^3/d	volume of west side adit flow at closure 1000 gpm

Ground Water Salts Calculation Input Parameters for the Stillwater Mine		**250 gpm untreated east side adit waters, 1,770 gpm treated west side adit waters, and 250 gpm treated Stillwater tailings waters are disposed of at the Stillwater Mine percolation ponds**	
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, $\mathbf{k_{SVR}}$	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, $\mathbf{k_E}$	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, $\mathbf{L_{SVR}}$	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, $\mathbf{W_{SVR}}$	507 ft		2008 MPDES Permit page 3
length of mixing zone, $\mathbf{L_E}$	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, $\mathbf{W_E}$	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, $\mathbf{A_{SVR}}$	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_E}$	9,750 ft		D * W, allowed by 17.30.517(d)
$\mathbf{Q_{SVR}=k_{SVR}iA_{SVR}}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_E=k_EiA_E}$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d)
ambient TDS concentration in ground water at Stillwater Mine (MW-10A), $\mathbf{C_A}$	81 mg/L	126 µmhos/cm	average concentration of TDS in ambient ground water at SMC MW-10A

projected ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	524 mg/L	**817** µmhos/cm	average concentration of TDS from percolation of 770 gpm west side adit waters + Stillwater tailings waters + east side adit waters
projected ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone	438 mg/L	**684** µmhos/cm	cumulative concentration of TDS from Stillwater East Side percolation plus percolation of 1000 gpm west side adit waters at Stillwater Valley Ranch
The EC of ground water at Stillwater Mine meets Class I Beneficial Use criterion.			
Stillwater River salts concentration below Stillwater Mine		**250 gpm untreated east side adit waters, 1,770 gpm treated west side adit waters, and 250 gpm treated Stillwater tailings waters are disposed at the Stillwater Mine percolation ponds**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 2008 MPDES
receiving stream ambient concentration, $\mathbf{C_s}$	45 mg/L	70 µmhos/cm	2008 MPDES Statement of Basis, p 9
ground water discharge volume, $\mathbf{Q_d}$	654,525 ft^3/d	7.6 cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	438 mg/L	684 µmhos/cm	projected ground water EC prior to discharge to Stillwater River
projected Stillwater River TDS Concentration at Stillwater Mine	**122 mg/L**	190 µmhos/cm	projected EC in Stillwater River at point of discharge
The TDS concentration in the Stillwater River at the Stillwater Mine would not exceed the 250 mg/L recommendation for protection of trout eggs.			
Proposed Alternative 2A Option 1, 650 gpm - The 250 gpm of untreated east side adit water would be disposed of in the east side percolation ponds. The 400 gpm west side adit water would be mixed and treated with 600 gpm Stillwater tailings water and routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. All these waters would be routed for disposal at the Hertzler Ranch LAD area.			
TDS loading at Stillwater Mine		**250 gpm untreated east side adit waters disposed at the Stillwater Mine percolation ponds**	
volume of east side adit water--percolated at east side perc ponds	48,128 ft^3/d	250 gpm (24 hr)	east side adit flow rate; personal communication R Weimer 2/18/2009
east side adit water TDS concentration	250 mg/L	48,128 ft^3/d	250 gpm flow in cubic feet per day (east side adit, Stillwater tailings waters, and pivot 6 rate)
daily TDS load discharged at Stillwater Mine during closure	**750** pound/day	120 days	length of closure
total TDS load disposed at Stillwater Mine during closure	**90,000** pound/year	192,513 ft^3/d	volume of west side adit flow at closure 1000 gpm
projected ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	183 mg/L	**286** µmhos/cm	
projected ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone	112 mg/L	**174** µmhos/cm	
projected Stillwater River TDS Concentration at Stillwater Mine	**51 mg/L**		
The analysis for Proposed Action Option 1, 2,020 gpm adit and Stillwater Tailings waters disposal option at the Stillwater Mine indicates that disposal of a much higher load of salt will not result in ground water or surface water TDS effects. No further analysis for percolation of 250 gpm east side adit water at the Stillwater Mine will be completed.			
Hydraulic Loading to Hertzler Ranch LAD		**400 gpm treated west side adit water plus 600 gpm treated Stillwater Tailings water would be routed to Hertzler Ranch LAD storage pond containing 100 MG treated adit water plus 45 MG untreated Hertzler Tailings waters**	
volume of adit water days 1-41	23 MG	58 MG	volume of adit water days 42-142
Stillwater tailings impoundment waters volume	35 MG	142 days	length of extended LAD season
Hertzler Ranch LAD Storage Pond volume	100 MG	45 MG	Hertzler Ranch tailings impoundment waters volume
number of days to dewater Stillwater Tailings Impoundment	41 days	491 mg/L	concentration of Hertzler Ranch LAD storage pond prior to tailings waters mixing
rate to dewater **Stillwater tailings** impoundment (BTS capacity)	600 gpm (24 hr)	1,200 gpm (12 hr)	rate to dewater **Stillwater tailings** impoundment (BTS capacity)
rate to dewater Hertzler Ranch **LAD storage pond** in 120 days	579 gpm (24 hr)	1,157 gpm (12 hr)	rate to dewater Hertzler Ranch LAD storage pond in 120 days

west side adit water flow rate	**400** gpm (24 hr)	800 gpm (12 hr)	**west side adit** water flow rate
rate to dewater **Hertzler Ranch tailings** impoundment in 120 days	260 gpm (24 hr)	521 gpm (12 hr)	rate to dewater **Hertzler Ranch tailings** impoundment in 120 days
operational application rate used at Hertzler Ranch achieving 80% nitrogen removal efficiency SMC monitoring data	1,375 gpm (24 hr)	2,750 gpm (12 hr)	operational application rate used at Hertzler Ranch achieving 80% TIN removal efficiency SMC monitoring data
total rate of water needing disposal at closure (adit plus Stillwater tailings plus Hertzler Ranch tailings plus Hertzler LAD storage pond)	**1,839** gpm (24 hr)	**3,678** gpm (12 hr)	total rate of water needing disposal at closure (adit plus Stillwater tailings plus Hertzler Ranch tailings plus Hertzler LAD storage pond)
total volume of water needing disposal at closure	**262** MG	**281** MG	volume that can be LAD at maximum rate for extended LAD season

If the LAD season is extended to 142 days, the hydraulic load of 450 gpm treated adit water plus 600 gpm treated Stillwater tailings waters, plus 45 MG untreated Hertzler tailings waters and 100 MG Hertzler Ranch LAD storage pond waters can be managed at the Hertzler Ranch.

TDS loading at Hertzler Ranch LAD		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
TDS concentration of west side adit waters (SMC monitoring data)	491 mg/L	766 µmhos/cm	west side adit water EC
TDS concentration of Stillwater and Hertzler tailings impoundment waters	1,870 mg/L	2,917 µmhos/cm	Hertzler Ranch tailings impoundment waters EC
weighted TDS concentration of treated adit plus Stillwater tailings waters	1,318 mg/L	890 mg/L	weighted TDS concentration of adit plus Hertzler tailings waters plus Stillwater tailings waters plus stored LAD pond waters **(days 1-41)**
volume of water LAD days 1-41	80 MG	1,388 µmhos/cm	weighted EC of adit plus Hertzler tailings waters plus Stillwater tailings waters plus stored LAD pond waters **(days 1-41)**
volume upper LAD Discharge; P1, P2, P3; no evaporation, $\mathbf{V_2}$	154,011 ft^3/d	940 mg/L	weighted TDS concentration of adit plus Hertzler tailings waters plus stored LAD pond waters **(days 42-142)**
volume lower LAD Discharge; P4, P5, P6; no evaporation, $\mathbf{V_3}$	110,695 ft^3/d	1,467 µmhos/cm	weighted EC of adit plus Hertzler tailings waters plus stored LAD pond waters **(days 42-142)**
daily load of TDS disposed at closure at Hertzler Ranch	**15,163** lb/day	1,600 gpm	application rate of Hertzler Ranch Upper LAD, pers. comm. R Weimer 2009
total TDS load disposed at Hertzler Ranch during closure	**2,153,136** lb	1,150 gpm	application rate of Hertzler Ranch Lower LAD, pers. comm. R Weimer 2009
annual TDS load per acre during closure at Hertzler Ranch	**8,156** lb/ac/yr	264 ac	LAD area at Hertzler Ranch
annual TDS load per square foot at closure	**0.2** $lb/ft^2/yr$	142 days	length of extended LAD season

Input parameters and assumptions for TDS calculations at Hertzler Ranch		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
TDS concentration in ambient ground water (HMW-4, SMC monitoring data)	150 mg/L	234 µmhos/cm	SMC Monitoring Reports
weighted TDS concentration in Hertlzer Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	919 mg/L	1,434 µmhos/cm	concentration of mixed Hertzler Ranch LAD storage pond water (treated adit water, treated Stillwater tailings waters, untreated Hertzler Ranch tailings waters)
weighted TDS concentration in upper and lower Hertzler Ranch LAD discharge, $\mathbf{C_2}$, $\mathbf{C_3}$	1,314 mg/L	2,050 µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
TDS concentration in Hertzler Ranch tailings impoundment liner leakage, $\mathbf{C_4}$	1,870 mg/L	2,917 µmhos/cm	
volume upper Hertzler Ranch LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d		

volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d		
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d		
volume lower Hertzler Ranch LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487 ft^3/d		
Ground Water concentrations at Hertzler Ranch		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
ground water concentration area $\mathbf{Z_1}$	331 mg/L	516 µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area $\mathbf{Z_2}$	761 mg/L	1,187 µmhos/cm	loading calculation for Ground Water zone Z_2; **does not meet Class I Beneficial Use**
ground water concentration area $\mathbf{Z_4}$	1,593 mg/L	2,485 µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
projected ground water EC concentration in $\mathbf{Z_3}$ at compliance point HMW-10	610 mg/L	**952** µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
EC concentration in $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	473 mg/L	738 µmhos/cm	projected ground water concentration prior to discharge to Stillwater River

The EC of ground water below Hertzler Ranch LAD at the compliance point (HMW-10) just prior to discharge into the Stillwater River meets the Class I Beneficial Use criterion.

Stillwater River concentration below Hertzler Ranch		**Stillwater tailings impoundment dewatered at 600 gpm and treated days 1-41; 400 gpm treated west side adit waters plus 100 MG stored treated adit waters in LAD storage pond plus 45 MG untreated Hertzler tailings waters LAD at Hertzler Ranch**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, $\mathbf{C_s}$	45 mg/L		Statement of Basis, MPDES permit
ground water discharge volume, $\mathbf{Q_d}$	669,071 ft^3/d	7.7 cfs	ground water discharge volume in cubic feet per second
ground water discharge concentration to Stillwater River, $\mathbf{C_d}$	473 mg/L		projected ground water concentration prior to discharge to Stillwater River
projected Stillwater River concentration	**130 mg/L**	203 µmhos/cm	projected EC in Stillwater River at point of discharge

The TDS concentration in the Stillwater River below the Hertzler Ranch LAD is less than the 250 mg/L recommendation for the protection of trout eggs.

Proposed Alternative 2A Option 2, 650 gpm - The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. The 400 gpm west side adit water would be mixed and treated with 600 gpm Stillwater tailings water and 716 gpm of that flow would be routed to the east percolation ponds for disposal. The other 284 gpm would be routed to the Hertzler Ranch LAD storage pond with up to 45 MG of untreated Hertzler Ranch tailings waters. The Hertzler Ranch LAD storage pond would contain 100 MG of treated adit water for disposal at the Hertzler Ranch LAD area.

Hydraulic loading to Stillwater Mine	966 gpm (24 hr)	**250 gpm untreated east side adit waters plus 716 gpm mixed treated west side adit plus Stillwater Tailings waters disposed at the Stillwater Mine percolation ponds**

The hydraulic load of 966 gpm (250 gpm untreated east side adit plus 716 gpm mixed treated west side adit plus Stillwater tailings waters) can be managed at the east side percolation ponds.

TDS loading at Stillwater Mine		**250 gpm untreated east side adit waters plus 716 gpm mixed treated west side adit plus Stillwater Tailings waters disposed at the Stillwater Mine percolation ponds**	
volume of east side adit water--percolated at east side perc ponds	48,128 ft^3/d	250 gpm (24 hr)	east side adit flow rate; personal communication R Weimer 2/18/2009
east side adit water TDS concentration	250 mg/L	390 µmhos/cm	EC of untreated east side adit water
TDS concentration of west side adit waters (SMC monitoring data)	491 mg/L	766 µmhos/cm	west side adit water EC
TDS concentration of Stillwater tailings impoundment waters	1,870 mg/L	2,917 µmhos/cm	Stillwater tailings impoundment waters EC

volume of mixed treated west side adit plus treated Stillwater tailings waters	137,840 ft^3/d	716 gpm (24 hr)	volume of mixed treated west side adit plus Stillwater tailings waters
TDS concentration of mixed untreated east side adit plus treated west side adit plus Stillwater tailings waters	**1,042** mg/L	1,625 µmhos/cm	EC of mixed treated west side adit plus Stillwater tailings waters
daily TDS load discharged at Stillwater Mine during closure	**9,702** pound/day	120 days	length of closure
total TDS load disposed at Stillwater Mine during closure	**1,164,240** pound/year	192,513 ft^3/d	volume of west side adit flow at closure 1000 gpm
TDS and EC calculations for ground water at Stillwater Mine		**250 gpm untreated east side adit waters plus 716 gpm mixed treated west side adit plus Stillwater Tailings waters disposed at the Stillwater Mine percolation ponds**	
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, k_{SVR}	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, k_E	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, L_{SVR}	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, W_{SVR}	507 ft		2008 MPDES Permit page 3
length of mixing zone, L_E	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, W_E	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, A_{SVR}	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_E	9,750 ft		D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d)
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d)
ambient TDS concentration in ground water at Stillwater Mine (MW-10A), C_A	81 mg/L	126 µmhos/cm	average concentration of TDS in ambient ground water at SMC MW-10A
projected ground water concentration at end of Stillwater East Side Percolation Pond mixing zone	863	**1,346** µmhos/cm	**exceeds the Class I Beneficial use criterion of 1,000 mhos/cm just prior to entering the mixing zone for the Stillwater Valley Ranch percolation ponds.**
projected ground water concentration at end of Stillwater Valley Ranch Percolation Pond mixing zone	454	**708** µmhos/cm	projected concentration in ground water just prior to discharge to Stillwater River
The EC of ground water at the end of the Stillwater Valley Ranch mixing zone just prior to discharge into the Stillwater River meets the Class I Beneficial Use criterion.			
Stillwater River salts concentration below Stillwater Mine		**250 gpm untreated east side adit waters plus 716 gpm mixed treated west side adit plus Stillwater Tailings waters disposed at the Stillwater Mine percolation ponds**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	
receiving stream ambient concentration, C_s	45 mg/L	70 µmhos/cm	EC of receiving stream
ground water discharge volume, Q_d	355,359 ft^3/d	4.1 cfs	ground water discharge volume in cubic feet per second
ground water discharge concentration to Stillwater River, C_d	454 mg/L	708 µmhos/cm	projected EC of ground water just prior to discharge to Stillwater River
projected Stillwater River TDS Concentration at Stillwater Mine	**93 mg/L**	144 µmhos/cm	projected EC of Stillwater River at SMC-11
The TDS concentration in surface water is below the 250 mg/L recommendation for protection of trout eggs.			

Hydraulic Loading to Hertzler Ranch LAD		**284 gpm of mixed treated west side adit plus Stillwater tailings waters would be routed to the Hertzler Ranch LAD pond with 45 MG Hertzler Ranch tailings waters and 100 MG Hertzler Ranch LAD pond stored waters**		
volume of mixed treated west side adit plus treated Stillwater tailings waters	284 gpm (24 hr)	54,674 ft^3/d	volume of mixed treated west side adit plus treated Stillwater tailings waters	
Hertzler Ranch LAD Storage Pond volume	100 MG	49 MG	volume of mixed treated west side adit plus treated Stillwater tailings waters	
Hertzler Ranch tailings impoundment waters volume	45 MG	120 days	length of closure	
total volume of water needing disposal at closure	**194** MG	**238** MG	volume of water that can be managed at Hertzler Ranch LAD in one season	
The volume of water routed to Hertzler Ranch LAD in Option 2 can be managed at Hertzler Ranch LAD.				
TDS loading at Hertzler Ranch LAD		**284 gpm mixed treated west side adit waters plus Stillwater tailings waters plus 45 MG Hertzler Ranch tailings waters and 100 MG Hertzler Ranch LAD pond stored waters**		
volume of mixed adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond	49 MG	284 gpm (24 hr)	volume of mixed treated adit water routed to Hertzler Ranch LAD storage pond	
Hertzler Ranch LAD Storage Pond volume	100 MG	120 days	length of extended LAD season	
number of days to dewater Stillwater Tailings Impoundment	41 days	45 MG	Hertzler Ranch tailings impoundment waters volume	
TDS concentration of west side adit waters (SMC monitoring data)	491 mg/L	766 µmhos/cm	west side adit water EC	
TDS concentration of Stillwater and Hertzler tailings impoundment waters	1,870 mg/L	2,917 µmhos/cm	Hertzler Ranch tailings impoundment waters EC	
weighted TDS concentration of mixed treated west side adit plus Stillwater tailings waters plus Hertzer tailings waters plus stored waters	**950** mg/L	1,482 µmhos/cm	weighted EC of mixed treated west side adit plus Stillwater tailings waters plus Hertzer tailings waters plus stored waters	
volume upper LAD Discharge; P1, P2, P3; no evaporation, V_2	154,011 ft^3/d	**1,359** mg/L	concentrated TDS of land applied waters	
volume lower LAD Discharge; P4, P5, P6; no evaporation, V_3	110,695 ft^3/d	2,119 µmhos/cm	concentration of Hertzler Ranch LAD storage pond prior to tailings waters mixing	
daily load of TDS disposed at closure at Hertzler Ranch	**15,676** lb/day	1,600 gpm (12 hr)	application rate of Hertzler Ranch Upper LAD; pers. comm. R Weimer 2009	
total TDS load disposed at Hertzler Ranch during closure	**1,881,102** lb	1,150 gpm (12 hr)	application rate of Hertzler Ranch Lower LAD; pers. comm. R Weimer 2009	
annual TDS load per acre during closure at Hertzler Ranch	**7,125** lb/ac/yr	264 ac	LAD area at Hertzler Ranch	
annual TDS load per square foot at closure	**0.2** $lbs/ft^2/yr$	120 days	length of LAD season	
Input parameters and assumptions for TDS calculations at Hertzler Ranch		**284 gpm mixed treated west side adit waters plus Stillwater tailings waters plus 45 MG Hertzler Ranch tailings waters and Hertzler Ranch LAD pond stored waters LAD at Hertzler Ranch**		
TDS concentration in ambient ground water (HMW-4, SMC monitoring data)	150 mg/L	234 µmhos/cm	SMC Monitoring Reports	
weighted TDS concentration in Hertlzer Ranch LAD storage pond liner leakage, C_1	950 mg/L	1,482 µmhos/cm	EC of mixed Hertzler Ranch LAD storage pond water (treated adit water, treated Stillwater tailings waters, untreated Hertzler Ranch tailings waters)	
weighted TDS concentration in upper and lower Hertzler Ranch LAD discharge, C_2, C_3	1,359 mg/L	2,119 µmhos/cm	EC of applied LAD waters, concentrated to account for evaporation; no TDS credit for plant uptake	
TDS concentration in Hertzler Ranch tailings impoundment liner leakage, C_4	1,870 mg/L	2,917 µmhos/cm	EC of Hertzler Ranch tailings impoundment liner leakage	

volume upper Hertzler Ranch LAD Discharge; P1, P2, P3; assume 30% evaporates, **V_2**	107,807 ft^3/d	2,750 gpm (12 hr)		application rate of Hertzler Ranch upper and lower LAD; pers. comm. R Weimer 2009
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), **V_4**	193 ft^3/d	194 MG		total volume of water at Hertzler Ranch needing disposal at closure
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), **V_1**	193 ft^3/d	98 days		time to land apply (at maximum rate) the volume of water at Hertzler Ranch needing disposal at closure
volume lower Hertzler Ranch LAD discharge: P4, P5, P6 assume 30% evaporates, **V_3**	77,487 ft^3/d			
Ground Water concentrations at Hertzler Ranch		**284 gpm mixed treated west side adit waters plus Stillwater tailings waters plus 45 MG Hertzler Ranch tailings waters and Hertzler Ranch LAD pond stored waters LAD at Hertzler Ranch**		
ground water concentration area **Z_1**	338 mg/L	528	µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area **Z_2**	784 mg/L	**1,224**	µmhos/cm	loading calculation for Ground Water zone Z_2, **exceeds Beneficial Use criterion**
ground water concentration area **Z_4**	1,593 mg/L	**2,485**	µmhos/cm	loading calculation for Ground Water zone Z_4, **exceeds Beneficial Use criterion**
projected ground water EC concentration in **Z_3** at compliance point HMW-10	628 mg/L	**979**	µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
EC concentration in **Z_5** from upgradient sources (**Z_1, Z_2, Z_3, Z_4**)	485 mg/L	757	µmhos/cm	projected ground water concentration prior to discharge to Stillwater River
The EC of ground water below Hertzler Ranch LAD at the compliance point (HMW-10) just prior to discharge into the Stillwater River meets the Class I Beneficial Use criterion.				
Stillwater River salts concentration below Hertzler Ranch		**284 gpm mixed treated west side adit waters plus Stillwater tailings waters plus 45 MG Hertzler Ranch tailings waters and Hertzler Ranch LAD pond stored waters LAD at Hertzler Ranch**		
receiving streamflow, **Q_s**	2,695,680 ft^3/d	31.2	cfs	7Q10 for Stillwater River at Stillwater Mine, 2008 MPDES
receiving stream ambient concentration, **C_s**	45 mg/L	70	µmhos/cm	
ground water discharge volume, **Q_d**	669,071 ft^3/d	7.7	cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, **C_d**	485 mg/L	757	µmhos/cm	projected concentration in ground water just prior to discharge to Stillwater River
projected Stillwater River salts concentration below Hertzler Ranch	**133 mg/L**	207	µmhos/cm	
The TDS concentration in surface water is below the 250 mg/L recommendation for protection of trout eggs.				

Spreadsheet 3A Nitrogen--Agency-Mitigated Alternative 3A Stillwater Mine and Hertzler Ranch LAD Closure Nitrogen Analyses

For Hertzler Ranch, these calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer; that is, no unsaturated zone was considered to determine concentrations of total nitrogen (TN) in ground water. To determine the concentration of TN in ground water at Hertzler Ranch, the agencies assume that there is a leak in the Hertzler Ranch LAD Storage Pond liner in ground water zone Z1; the upper LAD discharges to ground water zone Z2; the agencies assume there is a leak from the Hertzler Ranch tailings impoundment in ground water zone Z4; Z1, Z2, and Z4 flow into Z3 where the lower LAD is discharged, then Z3 flows into Z5. See Hertzler Ranch LAD Ground Water Figure. The concentration of treated adit water will vary with flow rate. To address potential administrative timing concerns due to unanticipated closure of the mine, a high precipitation year, or other contingency, and to take advantage of the seasonal flushing of TN observed during operations at Hertzler Ranch LAD and the Stillwater Mine, the Agency-Mitigated Alternative 3A would extend the closure period over two LAD seasons.

Agency-Mitigated Alternative 3A Option 1, 2,020 gpm: disposal of tailings waters from both Stillwater and Hertzler impoundments. *Stillwater Mine First Season, Days 1-90:* The 250 gpm of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds then routed underground day 91. *Stillwater Mine First Season, Days 1-97:* 250 gpm Stillwater tailings waters mixed and treated with 1,770 gpm west side adit water and routed to the Stillwater Mine percolation ponds. Stillwater Mine, First Season, From day 98, all untreated adit water would be routed underground. *Hertzler Ranch, First Season, Days 1-120:* Up to 260 gpm of the untreated 45 MG Hertzler Ranch tailings waters would be routed to the 100 MG of treated adit water in the Hertzler Ranch LAD storage pond and the mixed adit and tailings waters would be disposed at the Hertzler Ranch LAD area. Hertzler Ranch, Second Season: Any excess water that cannot be disposed the first year would be land applied at Hertzler Ranch.

		50 pound/day	historical maximum combined discharged total nitrogen load from Stillwater Mine after BTS treatment
The BTS system is assumed to treat up to 2,020 gpm (24 hr)		**1,770** gpm (24 hr)	**west side adit flow rate** at closure
volume of **Stillwater tailings** waters	35 MG	250 gpm (24 hr)	**Stillwater tailings flow rate** at closure; fixed by pumping rate
volume of Hertzler Ranch **LAD storage pond**	100 MG	2.4 mg/L	treated concentration of adit waters based on historical max total nitrogen load
volume of **Hertzler Ranch tailings** impoundment	45 MG	10.0 mg/L	total nitrogen concentration of tailings waters based on 80% treatment efficiency
length of LAD season	120 days	3.3 mg/L	weighted total nitrogen concentration of treated west side adit plus Stillwater tailings waters
rate of Hertzler Ranch **upper LAD**	1,600 gpm (12 hr)	521 gpm (12 hr)	rate to dewater Hertzler Ranch Tailings Impoundment in 120 days
rate of Hertzler Ranch upper LAD	154,011 ft^3/d	50 mg/L	**Hertzler Ranch tailings** impoundment waters **concentration**, SMC Monitoring Data
rate of Hertzler Ranch **lower LAD**	1,150 gpm (12 hr)	1,157 gpm (12 hr)	rate to dewater the Hertzler Ranch LAD storage pond in 120 days
rate of Hertzler Ranch lower LAD	110,695 ft^3/d	2.4 mg/L	**concentration of Hertzler Ranch LAD storage pond** prior to dewatering tailings impoundments
		17.1 mg/L	weighted total nitrogen concentration of mixed Hertzler Ranch LAD storage pond water (treated adit water plus untreated Hertzler Ranch tailings waters)
Input Parameters for Ground Water Calculations Hertzler Ranch LAD			**Source of Data**
depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, $\mathbf{k_1}$ from LAD storage pond	25 ft/d		from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper LAD	300 ft/d		from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower LAD	600 ft/d		from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
hydraulic conductivity, $\mathbf{k_4}$ from tailings impoundment	2 ft/d		from Hertzler Tailings Impoundment Seepage Analysis, Hydrometrics 2003
gradient, **i**	0.01		estimated, from Hertzler Tailings Impoundment Seepage Analysis Hydrometrics 2003
width of source (Hertzler Ranch LAD storage pond liner leakage)	10 ft		assumed width based on point seep, Hydrometrics 2003
width of LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD storage pond liner leakage area, $\mathbf{L_1}$	1,800 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
length upper LAD, $\mathbf{L_2}$	4,800 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map

width of upper LAD at pivot P3	1,749 ft		personal communication R Weimer 3/17/2009
width of Upper LAD mixing zone $\mathbf{W_2}$	2,169 ft		width of source + (tan 5 * length) allowed by ARM 17.30.517(d)
length of lower LAD, $\mathbf{L_3}$	5,200 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Lower LAD at pivot P4	1,610 ft		personal communication R Weimer 3/17/2009
Width of Lower LAD mixing zone $\mathbf{W_3}$	2,065 ft		personal communication R Weimer 2/18/2009
Width of source (Hertzler Ranch tailings impoundment liner leakage)	10 ft		assumed width based on point seep, Hydrometrics 2003
width of mixing zone below Hertzler Ranch tailings impoundment liner leakage $\mathbf{W_4}$	124 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of W_4 zone, $\mathbf{L_4}$	1,300 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Mixing Zone to Stillwater River $\mathbf{W_5}$	2,215 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length below lower LAD, $\mathbf{L_5}$	3,600 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width below lower LAD	1,900 ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
cross sectional area of aquifer, $\mathbf{A_1}$	2,510 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_2}$	32,529 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_3}$	30,969 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_4}$	1,855 ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_5}$	33,221 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}=k_1iA_1$, ground water available for mixing	628 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_2}=k_2iA_2$, ground water available for mixing	97,588 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_3}=k_3iA_3$, ground water available for mixing	185,813 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_4}=k_4iA_4$, ground water available for mixing	37 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_5}=k_5iA_5$, ground water available for mixing	199,325 ft^3/d		calculation per 17.30.517(d)
Hydraulic imput parameters		10.7 gpm/ac	Hertzler Ranch LAD operational application rate achieving 85% total nitrogen removal efficiency; SMC monitoring data
Stillwater tailings impoundment waters **volume**	35 MG	3.3 mg/L	weighted total nitrogen concentration of treated west side adit plus Stillwater tailings waters
days to dewater Stillwater tailings impoundment at given rate	97 days	250 gpm (24 hr)	rate to dewater Stillwater tailings impoundment based on available BTS capacity
Hertzler Ranch tailings impoundment waters **volume**	45 MG	50 mg/L	total nitrogen concentration of untreated Hertzler tailings waters
rate to dewater Hertzler Ranch Tailings Impoundment in 120 days	521 gpm (12 hr)	260 gpm (24 hr)	rate to dewater Hertzler Ranch Tailings Impoundment in 120 days
Hertzler Ranch LAD **Storage Pond volume**	100 MG	111,408 ft^3/12 hr	LAD 12 hour dewater rate used to compare with 12 hour LAD application rate
rate to dewater Hertzler Ranch LAD storage pond in 120 days	1,157 gpm (12 hr)	2.4 mg/L	concentration of LAD storage pond prior to tailings waters mixing
maximum Hertzler Ranch LAD storage pond volume	834,000,000 ft^3	17.1 mg/L	weighted average concentration of **mixed LAD storage pond water (Hertzler tailings plus stored waters)**
capacity of east side percolation pond (MPDES Statement of Basis, p 3)	2,000 gpm (24 hr)	2,000 gpm (24 hr)	capacity of Stillwater Valley Ranch percolation ponds (MPDES Statement of Basis, p. 3)

FIRST SEASON *Stillwater Mine* Closure Hydraulic Load	**Days 1-90: untreated east side adit water and treated west side adit waters plus treated Stillwater tailings waters would be routed to Stillwater Mine east side and Stillwater Valley Ranch percolation ponds.**		
east side adit water	250 gpm (24 hr)	0.2 mg/L	total nitrogen concentration of untreated east side adit water
treated west side adit water	1,770 gpm (24 hr)	192,513 ft^3/d	1000 gpm converted to cubic feet per day
treated Stillwater tailings waters	250 gpm (24 hr)	1,020 gpm (24 hr)	volume of water percolated at Stillwater Valley Ranch percolation ponds
total rate of waters to be percolated at Stillwater Mine	2,270 gpm (24 hr)	1,250 gpm (24 hr)	volume of water percolated at east side percolation ponds

The percolation capacity of the Stillwater Mine percolation ponds (East Side Ponds plus Stillwater Valley Ranch Ponds) is adequate to manage the hydraulic load of 2,020 gpm adit waters plus 250 gpm Stillwater tailings waters.

FIRST SEASON *Hertzler Ranch* Closure Hydraulic Load	**Days 1-120: untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**		
Days 1 - 120: water entering Hertzler Ranch LAD storage pond	521 gpm (12 hr)	260 gpm (24 hr)	Hertzler Ranch tailings waters pumped to Hertzler Ranch LAD storage pond
rate stored water pumped from Hertzler Ranch LAD storage pond	1,157 gpm (12 hr)	579 gpm (24 hr)	pumping rate of 100 MG stored Hertzler Ranch LAD storage pond waters
total volume of waters to be LAD	1,678 gpm (12 hr)	839 gpm (24 hr)	required LAD application rate to dispose of waters
daily maximum LAD design capacity	2,750 gpm (12 hr)	1,375 gpm (24 hr)	maximum application rate at Hertzler Ranch LAD to achieve 80% total nitrogen treatment efficiency

By percolating east and west side adit and Stillwater tailings waters at the Stillwater Mine, the hydraulic load all of the Hertzler Ranch waters may be managed at Hertzler Ranch in one season unless potential problems such as high precipitation year, unanticipated closure, etc. occur.

FIRST SEASON Stillwater Mine Closure total nitrogen load		**Days 1-90: 250 gpm untreated east side adit water, 1,770 gpm treated west side adit water, plus 250 gpm treated Stillwater tailings waters would be routed to Stillwater Mine east side (1,250 gpm) and Stillwater Valley Ranch (1,020 gpm) percolation ponds.**	
east side adit water pumping rate	**250** gpm (24 hr)	0.2 mg/L	total nitrogen concentration of untreated east side adit water from SMC Monitoring Data
contribution of east side adit water to Stillwater River total nitrogen load at Stillwater Mine	0.6 pound/day		calculated from SMC Monitoring Data
Stillwater waste rock dumps total nitrogen load from infiltrating precipitation	11 pound/day		Hertzler Ranch EIS 1998 page 4-3
treated adit water total nitrogen load based on SMC operational data since commissioning of BTS	50 pound/day	**1,770** gpm (24 hr)	adit flow rate at closure
Stillwater tailings water load based on BTS 80% total nitrogen removal efficiency	30 pound/day	250 gpm (24 hr)	Stillwater tailings waters pumping rate at closure
Days 1-90 daily total nitrogen load percolated at Stillwater Mine	**92** pound/day		**The closure nitrogen load meets the MPDES total nitrogen limit of 100 pounds per day at the Stillwater Mine; protective of surface water, no exceedances of ground water standards are expected outside the mixing zone; on day 98 the Stillwater tailings impoundment is dewatered and all adit waters are routed underground; no direct discharge occurs to surface water**
Days 91-97 daily total nitrogen load percolated at Stillwater Mine	**91** pound/day		
After Day 98 daily total nitrogen load infiltrating from waste rock dumps at Stillwater Mine	**11** pound/day		Please see Spreadsheet 2A total nitrogen 2,020 gpm Option 2 for calculations of actual ground and surface water concentrations at a discharge of 92 lbs/day total nitrogen load.

The daily total nitrogen load at the Stillwater Mine complies with the MPDES total nitrogen permit limit of 100 pounds per day, which is protective of the Stillwater River at the Stillwater Mine. No further ground and surface water total nitrogen calculations will be made if the total nitrogen load is less than 92 lbs/day.

FIRST SEASON Hertzler Ranch Input parameters and assumptions for total nitrogen load and concentrations					**Days 1-120: untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**
concentration of total nitrogen in ambient ground water (HMW-4)	0.2	mg/L	1,678	gpm (12 hr)	FIRST SEASON LAD daily application rate; P1, P2, P3 of upper LAD and P6 of lower LAD needed
concentration of total nitrogen in Hertzler Ranch LAD storage pond liner leakage, C_1	17.1	mg/L			weighted concentration of mixed Hertzler Ranch LAD storage pond water (treated adit water and untreated Hertzler Ranch tailings waters); instantaneous mixing assumed
concentration of total nitrogen in upper and lower LAD discharge (80% post plant uptake credit), C_2, C_3	4.9	mg/L			80% total nitrogen treatment efficiency achieved at 2,750 gpm (12 hr) application rate
concentration of total nitrogen in Hertzler Ranch tailings impoundment liner leakage, C_4	4	mg/L			assume equal to Hertzler Ranch tailings impoundment underdrain concentration, SMC Monitoring Data
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates, V_2	107,807	ft^3/d	1,600	gpm	Upper LAD Discharge total application rate from pivots P1, P2, P3; CES 2008
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), V_4	193	ft^3/d	33,690	ft^3/d	pivot P1; 350 gpm 12 hour maximum application rate; CES 2008
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), V_1	193	ft^3/d	38,503	ft^3/d	pivot P2: 400 gpm 12 hour maximum application rate; CES 2008
volume lower LAD discharge: P6 only assume 30% evaporates, V_3	16,845	ft^3/d	81,818	ft^3/d	pivot P3; 850 gpm 12 hour maximum application rate; CES 2008
daily load of total nitrogen disposed at closure at Hertzler Ranch	**99**	lb/day	43,316	ft^3/d	pivots P4, P5; 450 gpm 12 hour maximum application rate; CES 2008
total total nitrogen load disposed at Hertzler Ranch during closure (120 days)	**11,835**	lbs	24,064	ft^3/d	pivot P6; 250 gpm for 12 hour application rate; CES 2008
Annual total nitrogen load per acre per year (264 ac)	**45**	lb/ac/yr			loading calculation based on flow rates and weighted average concentration of mixed LAD storage pond water

Ground Water concentrations at Hertzler Ranch			**Days 1-120: untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**
ground water concentration area Z_1	4.2	mg/L	loading calculation for Ground Water zone Z_1
ground water concentration area Z_2	2.7	mg/L	loading calculation for Ground Water zone Z_2
ground water concentration area Z_4	3.4	mg/L	loading calculation for Ground Water zone Z_4
ground water concentration in Z_3 from Z_1, Z_2, Z_3, Z_4	**1.6**	**mg/L**	cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
ground water total nitrogen concentration in Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4)	1.2	mg/L	ground water concentration prior to discharge to Stillwater River

The total nitrogen concentration in ground water meets the DEQ-7 ground water criteria of 10 mg/L.

Stillwater River concentration below Hertzler Ranch				**Days 1-120: untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**
receiving streamflow, Q_s	2,695,680	ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, C_s	0.4	mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN is 0.14 mg/L
ground water discharge volume, Q_d	608,429	ft^3/d	7.0 cfs	ground water discharge in cubic feet per second
ground water discharge concentration to Stillwater River, C_d	1.2	mg/L		
Stillwater River concentration	**0.5**	**mg/L**		

The total nitrogen concentration in the Stillwater River is less than 1.0 mg/L.

Alternative 3A: 650 gpm adit water; disposal of tailings waters from both impoundments *FIRST SEASON. Stillwater Mine.* Days 1-41: untreated east side adit waters (250 gpm) percolated in east side percolation ponds; treated west side adit water (400 gpm) plus treated Stillwater tailings waters (600 gpm) routed to Hertzler Ranch LAD Storage Pond. Days 42-90: untreated east side adit water (250 gpm) percolated in east side percolation ponds; treated west side adit water (400 gpm) routed to Hertzler Ranch LAD Storage Pond. From day 91, all untreated adit water is routed underground. Some west side adit water may be routed through the BTS to maintain the microbes through the second season. *FIRST SEASON Hertzler Ranch.* Days 1-41: treated west side adit water (400 gpm) plus treated Stillwater tailings waters (600 gpm) routed to Hertzler Ranch LAD storage pond. Days 42-90: Untreated Hertzler Ranch tailings waters (396 gpm) plus treated west side adit water (400 gpm) routed to Hertzler Ranch LAD storage pond. After day 91, LAD of all waters remaining in the Hertzler Ranch storage pond. *SECOND LAD SEASON.* Any excess water that could not be disposed the first year due to high precipitation, bankruptcy, etc. would be land applied at Hertzler Ranch.

	Value	Unit	Description
	250	gpm (24 hr)	untreated **east side adit flow** rate at closure
The BTS system is assumed to treat up to 1,000 gpm (24 hr)	50	lb/day	historical maximum combined discharged total nitrogen load from Stillwater Mine after BTS treatment
	400	gpm (24 hr)	Stillwater Mine **west side adit flow** rate at closure
	600	gpm (24 hr)	**Stillwater tailings impoundment** pumping rate at closure
	10.4	mg/L	treated concentration of west side adit waters based on historical max total nitrogen load
	10.2	mg/L	mixed total nitrogen concentration of treated adit plus Stillwater tailings waters (80% total nitrogen removal efficiency assumed for tailings waters)
	396	gpm (24 hr)	rate to **dewater Hertzler Ranch tailings** impoundment
	50	mg/L	**Hertzler Ranch tailings impoundment** waters concentration
	10.4	mg/L	total nitrogen concentration of Hertzler Ranch LAD storage pond prior to dewatering tailings impoundments
	10.3	mg/L	**Days 1-41: total nitrogen concentration of mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters; assumes instantaneous mixing of total volumes**
	22.2	mg/L	**Days 42-90: total nitrogen concentration of remaining mixed Hertzler Ranch LAD storage pond water with Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes**
	31	mg/L	**Days 91-120: total nitrogen concentration of remaining mixed Hertzler Ranch LAD storage pond water with Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes**

FIRST SEASON *Hertzler Ranch* Hydraulic Capacity				**Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered; Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground); Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond**		
Stillwater tailings impoundment waters volume	35	MG		600	gpm (24 hr)	rate to dewater Stillwater tailings impoundment
number of days to dewater Stillwater tailings impoundment	41	days		400	gpm (24 hr)	Stillwater Mine west side adit flow rate at closure
Hertzler Ranch tailings impoundment waters volume	45	MG		396	gpm (24 hr)	rate to dewater Hertzler Ranch tailings impoundment
number of days to dewater Hertzler Ranch tailings impoundment	79	days		375	gpm (24 hr)	**Days 1-41:** rate to dewater Hertzler Ranch LAD storage pond based on LAD capacity
Hertzler Ranch LAD storage pond initial stored volume on **Day 1**	100	MG		579	gpm (24 hr)	**Days 42-90:** rate to dewater Hertzler Ranch LAD storage pond based on LAD capacity
volume in Hertzler Ranch LAD storage pond on **Day 42**	78	MG		1,375	gpm (24 hr)	**Days 91-120:** rate to dewater Hertzler Ranch LAD storage pond based on LAD capacity
Water entering Hertzler Ranch LAD storage pond **Days 1-41**	96,257	ft^3		1,000	gpm (24 hr)	west side adit water and Stillwater tailings waters
Water entering Hertzler Ranch LAD storage pond **Days 42-90**	76,579	ft^3		796	gpm (24 hr)	west side adit water and Hertzler Ranch tailings waters

volume in Hertzler Ranch LAD storage pond on **Day 91**	38 MG	48 days	number of days adit water is routed to Hertzler Ranch LAD pond after dewatering Stillwater impoundment
daily maximum LAD design capacity rate Days 1-120	264,706 ft^3	1,375 gpm (24 hr)	maximum application rate at Hertzler Ranch LAD to achieve 80% total nitrogen treatment efficiency

The hydraulic load all of 400 gpm treated west side adit water, 250 gpm Stillwater tailings impoundment waters, 396 gpm Hertzler Ranch tailings waters, and stored Hertzler Ranch LAD storage pond waters may be managed at Hertzler Ranch in one season unless potential problems such as high precipitation year, bankruptcy, etc. occur.

Hertzler Ranch Input parameters and assumptions for total nitrogen calculations

concentration of total nitrogen in ambient ground water at HMW-4	0.2 mg/L		SMC Monitoring Reports
concentration of total nitrogen in Hertzler Ranch tailings impoundment liner leakage, $\mathbf{C_4}$	4 mg/L		assume equal to tailings impoundment underdrain concentration
volume upper LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm (12 hr)	Upper LAD Discharge total application rate from pivots P1, P2, P3; CES 2008
concentration of total nitrogen in LAD discharge post plant uptake (80% credit), **Days 1-41** $\mathbf{C_2, C_3}$	2.9 mg/L	33,690 ft^3/d	pivot P1; 350 gpm 12 hour maximum application rate; CES 2008
concentration of total nitrogen in LAD discharge post plant uptake (80% credit), **Days 42-90** $\mathbf{C_2, C_3}$	6.3 mg/L	33,690 ft^3/d	pivot P1; 350 gpm 12 hour maximum application rate; CES 2008
concentration of total nitrogen in LAD discharge post plant uptake (80% credit), **Days 91-120** $\mathbf{C_2, C_3}$	8.9 mg/L	1,150 gpm (12 hr)	Lower LAD Discharge total application rate from pivots P4, P5, P6; CES 2008
volume of Hertzler Ranch LAD storage pond liner leakage(1 gpm), $\mathbf{V_1}$	193 ft^3/d	38,503 ft^3/d	pivot P2: 400 gpm 12 hour maximum application rate; CES 2008
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	81,818 ft^3/d	pivot P3; 850 gpm 12 hour maximum application rate; CES 2008
highest concentration of total nitrogen in Hertzler Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	31 mg/L	43,316 ft^3/d	pivots P4, P5; 450 gpm 12 hour maximum application rate; CES 2008
volume lower LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487 ft^3/d	24,064 ft^3/d	pivot P6; 250 gpm for 12 hour application rate; CES 2008
daily load of total nitrogen disposed at closure at Hertzler Ranch days 1-41	97 lb/day	209 lbs	**daily load of total nitrogen disposed at closure at Hertzler Ranch days 42-90**
total total nitrogen load disposed at Hertzler Ranch during closure (120 days)	**22,960** lbs	292 lbs	**daily load of total nitrogen disposed at closure at Hertzler Ranch days 91-120**
Annual total nitrogen load per acre per year (264 ac)	87 lb/ac/yr		
annual total nitrogen load per square foot per year (264 ac)	0.0 lbs/ft2/yr		

Ground water total nitrogen concentrations at Hertzler Ranch Days 1-41		**Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered**	
ground water total nitrogen concentration area $\mathbf{Z_1}$	7.4 mg/L		loading calculation for Ground Water zone Z_1
ground water total nitrogen concentration area $\mathbf{Z_2}$	1.6 mg/L		loading calculation for Ground Water zone Z_2
ground water total nitrogen concentration area $\mathbf{Z_4}$	3.1 mg/L		loading calculation for Ground Water zone Z_4
ground water total nitrogen concentration in $\mathbf{Z_3}$ from $\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$	**1.3 mg/L**		cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
total nitrogen concentration in ground water at $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	1.0 mg/L		ground water total nitrogen concentration just prior to discharge to Stillwater River

For this scenario Days 1-41, the total nitrogen concentration in ground water below Hertzler Ranch LAD is less than the DEQ-7 ground water criteria of 10 mg/L.

Stillwater River concentration below Hertzler Ranch Days 1-41		**Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.4 mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	669,071 ft^3/d	7.7 cfs	discharge through aquifer in cubic feet per second
discharge total nitrogen concentration to Stillwater River, $\mathbf{C_d}$	1.0 mg/L		
Stillwater River total nitrogen concentration	**0.5 mg/L**		

For this scenario Days 1-41, the total nitrogen concentration in the Stillwater River below the Hertzler Ranch LAD is less than 1.0 mg/L.

Ground water total nitrogen concentrations at Hertzler Ranch Days 42-90		**Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground)**	
ground water total nitrogen concentration area $\mathbf{Z_1}$	7.4 mg/L		loading calculation for Ground Water zone Z_1
ground water total nitrogen concentration area $\mathbf{Z_2}$	3.4 mg/L		loading calculation for Ground Water zone Z_2
ground water total nitrogen concentration area $\mathbf{Z_4}$	3.1 mg/L		loading calculation for Ground Water zone Z_4
ground water total nitrogen concentration in $\mathbf{Z_3}$ from $\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$	**2.6 mg/L**		cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
total nitrogen concentration in ground water at $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	1.9 mg/L		ground water concentration prior to discharge to Stillwater River

For this scenario Days 42-90, the total nitrogen concentration in ground water below the Hertzler Ranch LAD is less than the DEQ-7 ground water criteria of 10 mg/L. This concentration is slightly greater than the 2 mg/L above background trigger limit.

Stillwater River concentration below Hertzler Ranch Days 42-90			**Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground)**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.4	mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	669,071	ft^3/d	7.7 cfs	discharge through aquifer in cubic feet per second
ground water discharge concentration to Stillwater River, $\mathbf{C_d}$	1.9	mg/L		
Stillwater River concentration	**0.7**	**mg/L**		
For this scenario Days 42-90, the total nitrogen concentration in the Stillwater River below the Hertzler Ranch LAD is less than 1.0 mg/L.				
Ground water total nitrogen concentrations at Hertzler Ranch Days 91-120			**Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond; mixed waters land applied at full hydraulic capacity of Hertzler Ranch LAD**	
ground water total nitrogen concentration area $\mathbf{Z_1}$	7.4	mg/L		loading calculation for Ground Water zone Z_1
ground water total nitrogen concentration area $\mathbf{Z_2}$	4.7	mg/L		loading calculation for Ground Water zone Z_2
ground water total nitrogen concentration area $\mathbf{Z_4}$	3.1	mg/L		loading calculation for Ground Water zone Z_4
ground water total nitrogen concentration in $\mathbf{Z_3}$ from $\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$	**3.6**	**mg/L**		cumulative loading calculation for Ground Water zone Z_3, at compliance point HMW-10 from 1992 Hertzler Ranch EIS
total nitrogen concentration in ground water at $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	2.6	mg/L		ground water concentration prior to discharge to Stillwater River
For this scenario Days 91-120, the total nitrogen concentration in ground water is less than the DEQ-7 ground water criteria of 10 mg/L. This concentration is greater than the 2 mg/L above background trigger limit.				
Stillwater River concentration below Hertzler Ranch Days 91-120			**Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond; mixed waters land applied at full hydraulic capacity of Hertzler Ranch LAD**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient total nitrogen concentration, $\mathbf{C_s}$	0.4	mg/L		median ambient total nitrogen concentration at SMC-12A 1995-2008 SMC monitoring data, based on the MPDES permit for Stillwater Mine; ambient TIN is 0.14 mg/L
ground water discharge volume, $\mathbf{Q_d}$	669,071	ft^3/d	7.7 cfs	discharge through aquifer in cubic feet per second
ground water discharge concentration to Stillwater River, $\mathbf{C_d}$	2.6	mg/L		
Stillwater River total nitrogen concentration	**0.8**	**mg/L**		
For this scenario Days 91-120, the total nitrogen concentration in the Stillwater River below the Hertzler Ranch LAD is less than 1.0 mg/L.				
CLOSURE Stillwater Mine total nitrogen load to ground water from east side adit water disposal days 1-90 (no disposal at the mine the rest of the closure period)	**54**	lbs/18-mos	**untreated east side adit waters (250 gpm) percolated in east side percolation ponds; treated west side adit water (400 gpm) plus treated Stillwater tailings waters (600 gpm) routed to Hertzler Ranch LAD Storage Pond. Days 42-90: untreated east side adit water (250 gpm) percolated in east side; after day 91, all adit water is routed underground**	
waste rock dump total nitrogen load to ground water	**6,028**	lbs/18-mos		
Total total nitrogen load disposed to ground water at Stillwater Mine during closure period (548 days)	**6,082**	lbs/18-mos		
For this scenario Days 1-548, the 100 lbs/day MPDES permitted total nitrogen load is not exceeded at the Stillwater Mine, and the nitrogen concentrations do not exceed 10 mg/L in ground water or 1 mg/L in the Stillwater River below the mine.				

Spreadsheet 3A Salts--Agency-Mitigated Alternative 3A Stillwater Mine and Hertzler Ranch Salinity Analyses

For Hertzler Ranch, the calculations have been made according to the regulatory requirements (Montana Water Quality Act and Rules and Federal Clean Water Act) regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Hertzler Ranch LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer; that is, no unsaturated zone was considered to determine the concentrations of TDS in ground water. To determine the concentration of TDS in ground water at Hertzler Ranch, the agencies assume that there is a leak in the Hertzler Ranch LAD Storage Pond liner in ground water zone Z_1; the upper LAD discharges to ground water zone Z_2; assume there is a leak from the Hertzler Ranch tailings impoundment in ground water zone Z_4; zones Z_1, Z_2, and Z_4 flow into Z_3 where the lower LAD is discharged, then Z_3 flows into Z_5. Salts are not treated in the BTS/Anox or in the Hertzler Ranch LAD, so all salts are expected to flush through the soil column and unsaturated zone to ground water. The agencies assumed that the adit water TDS concentration will equal the median operational Stillwater Mine concentration. The Stillwater Mine MPDES has no TDS or electrical conductivity (EC) limit. To address potential administrative timing concerns due to unexpected closure of the mine, a high precipitation year, or other contingency, and to take advantage of the seasonal flushing of TDS observed during operations at Hertzler Ranch LAD and the Stillwater Mine, the Agency-Mitigated Alternative 3A would extend the closure period over two summer LAD seasons (18 months).

CLOSURE Agency-Mitigated Alternative 3A Option 1, 2,020 gpm: disposal of tailings waters from both Stillwater and Hertzler impoundments. *Stillwater Mine First Season, Days 1-90*: The 250 gpm of untreated east side adit water would be disposed in the Stillwater Mine east side percolation ponds then routed underground day 91. *Stillwater Mine First Season, Days 1-97:* Up to 250 gpm Stillwater tailings waters would be mixed and treated with 1,770 gpm west side adit water and routed to the Stillwater Mine percolation ponds. *Stillwater Mine, First Season*, From day 98, all untreated adit water would be routed underground. *Hertzler Ranch, First Season, Days 1-120:* Up to 260 gpm of the untreated 45 MG Hertzler Ranch tailings waters would be routed to the 100 MG of treated adit water in the Hertzler Ranch LAD storage pond and the mixed adit and tailings waters would be disposed at the Hertzler Ranch LAD area. *Hertzler Ranch, Second Season:* Any excess water that cannot be disposed the first year would be land applied at Hertzler Ranch.

1 mg/L TDS = 1.56 µmhos/cm		250	gpm (24 hr)	east side adit flow rate at closure
volume of 250 gpm in cubic feet per day	48,128 ft^3/d	1,770	gpm (24 hr)	west side adit flow rate at closure
volume of 1000 gpm in cubic feet per day	192,513 ft^3/d	491	mg/L	median Stillwater TDS west side adit water concentration, SMC Monitoring Data
calculated median Stillwater EC west side adit water concentration, from SMC TDS Monitoring Data	766 µmhos/cm	250	mg/L	average 2004-2008 Stillwater east side adit TDS concentration
average 2004-2008 Stillwater east side adit EC (calculated)	390 µmhos/cm	1,870	mg/L	concentration of TDS in both tailings impoundments: Stillwater and Hertzler Ranch
EC in both tailings impoundments: Stillwater and Hertzler Ranch	2,917 µmhos/cm	250	gpm (24 hr)	Stillwater tailings flow rate at closure; fixed by BTS capacity for TIN treatment
		521	gpm (12 hr)	rate to dewater Hertzler Ranch tailings Impoundment in 120 days
calculated EC in mixed west side adit plus Stillwater tailings waters	813 µmhos/cm	662	mg/L	weighted TDS concentration in mixed west side adit plus Stillwater tailings waters
calculated EC in mixed Hertzler Ranch LAD storage pond water and untreated Hertzler Ranch tailings waters	1,032 µmhos/cm	919	mg/L	weighted TDS concentration of mixed Hertzler Ranch LAD storage pond water (treated stored adit water) and untreated Hertzler Ranch tailings waters; assumes instantaneous mixing

Input Parameters for Hertzler Ranch Ground Water Calculations		**Source of Data**
depth of aquifer, **D**	15 ft	
hydraulic conductivity, $\mathbf{k_1}$ from Hertzler Ranch LAD storage pond	25 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_2}$ from upper Hertzler Ranch LAD	300 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_3}$ and $\mathbf{k_5}$ from lower Hertzler Ranch LAD	600 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
hydraulic conductivity, $\mathbf{k_4}$ from tailings impoundment	2 ft/d	from Hertzler Tailings Impoundment Seepage Analysis 2003
gradient, **i**	0.01	estimated, from Hertzler Tailings Impoundment Seepage Analysis
width of source (Hertzler Ranch LAD storage pond liner leakage)	10 ft	assumed width based on point seep, Hydrometrics 2003
width of Hertzler Ranch LAD storage pond liner leakage mixing zone, $\mathbf{W_1}$	167 ft	width of source + (tan 5 * length) allowed by 17.30.517(d)

angle of dispersion	0.087421693	tan 5°		allowed by 17.30.517(d)
length Hertzler Ranch LAD storage pond liner leakage area, L_1	1,800	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
length upper Hertzler Ranch LAD, L_2	4,800	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of upper Hertzler Ranch LAD at P3	1,749	ft		personal communication R Weimer 2/18/2009
width of Upper Hertzler Ranch LAD mixing zone W_2	2,169	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of lower Hertzler Ranch LAD, L_3	5,200	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Lower Hertzler Ranch LAD at P4	1,610	ft		personal communication R Weimer 2/18/2009
Width of Lower Hertzler Ranch LAD mixing zone W_3	2,065	ft		personal communication R Weimer 2/18/2009
Width of source (Hertzler Ranch tailings impoundment liner leakage)	10	ft		assumed width based on point seep, Hydrometrics 2003
width of mixing zone below Hertzler Ranch tailings impoundment liner leakage W_4	124	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of W_4 zone, L_4	1,300	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width of Mixing Zone to Stillwater River W_5	2,215	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
length below lower Hertzler Ranch LAD, L_5	3,600	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
width below lower Hertzler Ranch LAD	1,900	ft		from Hertzler Tailings Impoundment Seepage Analysis 2003 map
cross sectional area of aquifer, A_1	2,510	ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_2	32,529	ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_3	30,969	ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_4	1,855	ft^2		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_5	33,221	ft^2		D * W, allowed by 17.30.517(d)
Q_1=kiA, ground water available for mixing	628	ft^3/d		calculation per 17.30.517(d)
Q_2=kiA, ground water available for mixing	97,588	ft^3/d		calculation per 17.30.517(d)
Q_3=kiA, ground water available for mixing	185,813	ft^3/d		calculation per 17.30.517(d)
Q_4=kiA, ground water available for mixing	37	ft^3/d		calculation per 17.30.517(d)
Q_5=kiA, ground water available for mixing	199,325	ft^3/d		calculation per 17.30.517(d)
Stillwater tailings impoundment waters volume	35	MG	1,870 mg/L	TDS concentration of untreated Stillwater tailings waters
days to dewater Stillwater Tailings Impoundment at given rate	97	days	250 gpm (24 hr)	Stillwater tailings flow rate at closure; fixed by BTS capacity for TIN treatment
Hertzler Ranch tailings impoundment waters volume	45	MG	1,870 mg/L	concentration of untreated Hertzler tailings waters
rate to dewater Hertzler Ranch Tailings Impoundment in 120 days	521	gpm		
Hertzler LAD Storage Pond volume	100	MG	111,408 ft^3/12 h	Hertzler Ranch LAD 12 hour dewater rate used to compare with 12 hour Hertzler Ranch LAD application rate
12 hr rate to dewater Hertzler LAD storage pond in 120 days	1,157	gpm	491 mg/L	concentration of Hertzler Ranch LAD storage pond prior to tailings waters mixing
maximum Hertzler Ranch LAD storage pond volume	834,000,000	ft^3	919 mg/L	weighted TDS concentration of mixed Hertzler Ranch LAD storage pond water (treated stored adit water) and untreated Hertzler Ranch tailings waters; assumes instantaneous [illegible]

FIRST SEASON *Stillwater Mine* Hydraulic Capacity	**Days 1-90: untreated east side adit water and treated west side adit waters plus treated Stillwater tailings waters would be routed to Stillwater Mine east side and Stillwater Valley Ranch percolation ponds.**		
east side adit water	250 gpm (24 hr)	250 mg/L	percolated at east side percolation ponds; TDS concentration of water
treated west side adit water	1,770 gpm (24 hr)	662 mg/L	percolated at east side percolation ponds; TDS concentration of mixed treated water from BTS
treated Stillwater tailings waters	250 gpm (24 hr)	662 mg/L	percolated at east side percolation ponds; TDS concentration of mixed treated water from BTS
total rate of waters to be percolated at Stillwater Mine	2,270 gpm (24 hr)	2,300 gpm (24 hr)	minimum capacity for both east side and Stillwater Valley Ranch percolation ponds; MPDES State ment of Basis p.3
The percolation capacity of the east side percolation ponds (East Side Ponds plus Stillwater Valley Ranch Ponds) is adequate to manage the hydraulic load of 2,020 gpm adit waters plus 250 gpm Stillwater tailings waters.			
FIRST SEASON *Hertzler Ranch* Hydraulic Capacity	**Days 1-120: 45 MG untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**		
Days 1 - 120: water entering Hertzler Ranch LAD storage pond	521 gpm (12 hr)	260 gpm (24 hr)	Hertzler Ranch tailings waters pumped to Hertzler Ranch LAD storage pond
rate stored water pumped from Hertzler Ranch LAD storage pond	1,157 gpm (12 hr)	579 gpm (24 hr)	pumping rate of 100 MG stored Hertzler Ranch LAD storage pond waters
total volume of waters to be LAD	1,678 gpm (12 hr)	839 gpm (24 hr)	required LAD application rate to dispose of waters
daily maximum LAD design capacity	2,750 gpm (12 hr)	1,375 gpm (24 hr)	maximum application rate at Hertzler Ranch LAD to achieve 80% TIN treatment efficiency
By percolating adit and Stillwater tailings waters at the Stillwater Mine, the hydraulic load all of the Hertzler Ranch waters may be managed at Hertzler Ranch in one season unless potential problems such as high precipitation year, bankruptcy, etc. occur.			
FIRST SEASON *Stillwater Mine* TDS load	**Days 1-90: untreated east side adit water and treated west side adit waters plus treated Stillwater tailings waters would be routed to Stillwater Mine east side and Stillwater Valley Ranch percolation ponds.**		
east side adit water pumping rate	250 gpm (24 hr)	250 mg/L	TDS concentration of east side adit water from SMC Monitoring Data
east side adit water TDS load to Stillwater River at Stillwater Mine	750 lbs/day	662 mg/L	weighted TDS concentration in mixed west side adit plus Stillwater tailings waters
Stillwater waste rock dumps TDS load from percolating	no data lbs/day	1,770 gpm (24 hr)	west side adit flow rate at closure
treated adit water TDS load	14,054 lbs/day	250 gpm (24 hr)	Stillwater tailings waters pumping rate at closure
Stillwater tailings water load	1,985 lbs/day	97 days	time to dewater the Stillwater Tailings Impoundment at given rate
Days 1-90 daily TDS load percolated at Stillwater Mine	16,789 lbs/day		no MPDES TDS permit limit at the Stillwater Mine
Days 91-97 daily TDS load percolated at Stillwater Mine	16,039 lbs/day		no MPDES TDS permit limit at the Stillwater Mine
After Day 98 daily TDS load percolated at Stillwater Mine	0 lbs/day		no discharge at Stillwater Mine after day 98; Stillwater tailings impoundment dewatered and all adit waters routed underground
Days 1-97 total salts load percolated at Stillwater Mine	**1,623,267** lbs/18 months		total salts load disposed at Stillwater Mine at an adit flow rate of 2,020 gpm (24 hr)

Ground Water Salts Calculation Input Parameters for the Stillwater Mine		**Days 1-90: untreated east side adit water and treated west side adit waters plus treated Stillwater tailings waters would be routed to Stillwater Mine east side and Stillwater Valley Ranch percolation ponds.**	
depth of aquifer, **D**	15 ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
hydraulic conductivity east side percolation ponds, k_{SVR}	4,076 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
hydraulic conductivity east side percolation ponds, k_E	539 ft/day		SMC MPDES Permit Renewal Information (Hydrometrics 1995) used for 2008 renewal
gradient, **i**	0.006 ft/ft		Original Stillwater MPDES Permit calculations penciled in Hydrometrics 1995
length of mixing zone, L_{SVR}	500 ft		2008 MPDES Permit page 3
width of mixing zone at downgradient extent, W_{SVR}	507 ft		2008 MPDES Permit page 3
length of mixing zone, L_E	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, W_E	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, A_{SVR}	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, A_E	9,750 ft		D * W, allowed by 17.30.517(d)
$Q_{SVR}=k_{SVR}iA_{SVR}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d)
$Q_E=k_EiA_E$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d)
ambient TDS concentration in ground water at MW-10A Stillwater Mine	81 mg/L	126 µmhos/cm	median concentration of TDS in ambient ground water at SMC MW-10A
ground water TDS concentration at end of Stillwater east side percolation pond mixing zone	524 mg/L	**817** µmhos/cm	weighted concentration of TDS from percolation of 1000 gpm west side adit waters + 250 gpm east side adit waters
ground water TDS concentration at end of Stillwater Valley Ranch percolation pond mixing zone	438 mg/L	**684** µmhos/cm	**cumulative concentration** of TDS from Stillwater East Side percolation plus percolation of 1,000 gpm west side adit waters at Stillwater Valley Ranch

The EC in ground water meets the 1,000 µmhos/cm Class I Beneficial Use criterion at the Stillwater Mine.

Stillwater River salts concentration below Stillwater Mine		**Days 1-90: untreated east side adit water and treated west side adit waters plus treated Stillwater tailings waters would be routed to Stillwater Mine east side and Stillwater Valley Ranch percolation ponds.**	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	45 mg/L	70 µmhos/cm	2008 MPDES Statement of Basis, p 9
ground water discharge volume, Q_d	654,525 ft^3/d	7.6 cfs	ground water volume in cubic feet per second
discharge concentration to Stillwater River, C_d	438 mg/L	684 µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River TDS Concentration at Stillwater Mine	**122 mg/L**	190 µmhos/cm	

The TDS concentration in the Stillwater River at the Stillwater Mine is less than the 250 mg/L recommendation for the protection of trout eggs.

FIRST SEASON *Hertzler Ranch* Input parameters and assumptions for salts calculations at Hertzler Ranch		**Days 1-120: 45 MG untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**	
concentration of TDS in ambient ground water (HMW-4)	150 mg/L	234 µmhos/cm	SMC Monitoring Data
TDS concentration of Hertzler Ranch tailings impoundment liner leakage, C_4	1,870 mg/L	1,678 gpm (12 hr)	FIRST SEASON LAD daily application rate; P1, P2, P3 of upper LAD and P6 of lower LAD needed to manage water
TDS concentration of upper and lower Hertzler Ranch LAD discharge at C_2, C_3	1,314 mg/L		weighted TDS concentration of mixed Hertzler Ranch LAD storage pond water when concentrated by evaporation; no TDS credit for plant uptake
TDS concentration in Hertzler Ranch LAD storage pond liner leakage, C_1	919 mg/L		weighted TDS concentration of mixed Hertzler Ranch LAD storage pond water (treated stored adit water) and untreated Hertzler Ranch tailings waters; assumes instantaneous

volume upper Hertzler Ranch LAD Discharge, assumes 30% evaporates; P1, P2, P3; $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm	application rate of upper LAD, pers. comm. R Weimer 2009
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft3/d	33,690 ft^3/d	P1; 350 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft3/d	38,503 ft^3/d	P2: 400 gpm for 12 hour application rate
volume lower Hertzler Ranch LAD discharge, assumes 30% evaporates: P6; $\mathbf{V_3}$	16,845 ft^3/d	81,818 ft^3/d	P3; 850 gpm for 12 hour application rate
average daily TDS load disposed at closure at Hertzler Ranch	**16,435** lbs/day	43,316 ft^3/d	P4, P5; 450 gpm for 12 hour application rate
total TDS load disposed at Hertzler Ranch during closure, 120 days	**1,972,159** lbs	24,064 ft^3/d	P6; 250 gpm for 12 hour application rate
annual (120 days)TDS load per acre per year (265 ac)	**7,442** lbs/ac/yr		no MPDES permit at the Hertzler Ranch; ground water standards apply
annual (120 days) TDS load per square foot per year (265 ac)	**0.2** $lbs/ft^2/yr$		
Ground Water salts concentrations at Hertzler Ranch		**Days 1-120: 45 MG untreated Hertzler Ranch tailings waters plus up to 100 MG treated adit water in the Hertzler Ranch LAD storage pond would be routed to Hertzler Ranch LAD.**	
ground water concentration area $\mathbf{Z_1}$	331 mg/L	516 µmhos/cm	loading calculation Ground Water zone Z_1; TDS conversion 1 mg/L = 1.56 µmhos/cm
ground water concentration area $\mathbf{Z_2}$	761 mg/L	**1,187** µmhos/cm	loading calculation for Ground Water zone Z_2, **does not meet Class I Beneficial Use**
ground water concentration area $\mathbf{Z_4}$	1,593 mg/L	**2,485** µmhos/cm	loading calculation for Ground Water zone Z_4, **does not meet Class I Beneficial Use**
ground water concentration in $\mathbf{Z_3}$ at compliance point HMW-10	506 mg/L	**789** µmhos/cm	cumulative loading calculation for Ground Water zone Z_3 from upgradient sources (Z_1, Z_2, Z_3, Z_4); compliance point HMW-10 per 1998 Hertzler Ranch EIS
concentration in $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	389 mg/L	607 µmhos/cm	ground water concentration prior to discharge to Stillwater River
The EC in ground water at compliance well HMW-10 (Hertzler Ranch LAD) meets the 1,000 µmhos/cm Class I Beneficial Use criteria.			
Stillwater River salts concentration below Hertzler Ranch			
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs;actual streamflow is greater below Hertzler Ranch LAD
receiving stream ambient concentration, $\mathbf{C_s}$	44 mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, $\mathbf{Q_d}$	608,429 ft^3/d	7.0 cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	389 mg/L	607 µmhos/cm	ground water concentration prior to discharge to Stillwater River
TDS Stillwater River concentration	**108 mg/L**	**168 µmhos/cm**	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow
The TDS concentration in the Stillwater River below the Hertzler Ranch LAD is less than the 250 mg/L recommendation for the protection of trout eggs.			

Agency-Mitigated Alternative 3A Option 1, 650 gpm - Stillwater Mine First Season, Days 1-90: The 250 gpm of untreated east side adit water would be disposed in the east side percolation ponds. From day 91 on, the untreated east side adit water would be routed to the underground workings. *FIRST SEASON. Stillwater Mine. Days 1-41:* untreated east side adit waters (250 gpm) percolated in east side percolation ponds; treated west side adit water (400 gpm) plus treated Stillwater tailings waters (600 gpm) routed to Hertzler Ranch LAD storage pond. Days 42-90: untreated east side adit water (250 gpm) percolated in east side percolation ponds; treated west side adit water (400 gpm) routed to Hertzler Ranch LAD storage pond. *From day 91*, all untreated adit water is routed underground. Some west side adit water may be routed through the BTS to maintain the microbes through the second season. *FIRST SEASON Hertzler Ranch. Days 1-41:* The 400 gpm of treated west side adit water would be mixed and treated with 600 gpm of Stillwater tailings water and routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. Days 42-90: Up to 396 gpm of untreated Hertzler Ranch tailings waters would be routed with 400 gpm of treated west side adit water to the 100 MG of treated adit water in the Hertzler Ranch LAD storage pond and the mixed adit and tailings waters would be disposed at th LAD area. From Days 91 to 120, all water remaining in the Hertzler Ranch LAD storage pond would be land applied. SECOND LAD SEASON Hertzler Ranch. Any excess water that could not be disposed the first year due to high precipitation, bankruptcy, etc. would be land applied at Hertzler Ranch.

volume of 250 gpm in cubic feet per day	48,128 ft^3/d	**250** gpm (24 hr)	untreated east side adit flow rate at closure
volume of 1000 gpm in cubic feet per day	192,513 ft^3/d	250 mg/L	average 2004-2008 Stillwater east side adit TDS concentration
calculated median Stillwater EC west side adit water concentration, from SMC TDS Monitoring Data	766 µmhos/cm	**400** gpm (24 hr)	Stillwater Mine treated west side adit flow rate at closure
average 2004-2008 Stillwater east side adit EC (calculated)	390 µmhos/cm	491 mg/L	median Stillwater TDS west side adit water concentration, SMC Monitoring Data
EC in both tailings impoundments: Stillwater and Hertzler Ranch	2,917 µmhos/cm	600 gpm (24 hr)	Stillwater tailings impoundment pumping rate at closure
calculated EC in mixed west side adit plus Stillwater tailings waters	2,057 µmhos/cm	1,870 mg/L	concentration of TDS in both tailings impoundments: Stillwater and Hertzler Ranch
Days 1-41: EC mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing	1,241 µmhos/cm	396 gpm (24 hr)	rate to dewater Hertzler Ranch Tailings Impoundment
weighted TDS concentration in mixed west side adit plus Stillwater tailings waters	1,318 mg/L	491 mg/L	TDS concentration of Hertzler Ranch LAD storage pond prior to dewatering tailings impoundments
Days 1-41: TDS concentration of mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing	795 mg/L	1,241 µmhos/cm	**Days 1-41:** EC of mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing
Days 42-90: TDS concentration of remaining mixed west side adit water, Hertzler Ranch LAD storage pond water, plus Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes	1,060 mg/L	1,654 µmhos/cm	**Days 42-120:** EC of remaining mixed Hertzler Ranch LAD storage pond water with Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes
Days 91-120: TDS concentration of remaining mixed Hertzler Ranch LAD storage pond water with Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes	1,317 mg/L	2,054 µmhos/cm	**Days 91-120:** EC of remaining mixed Hertzler Ranch LAD storage pond water with Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes

FIRST SEASON *Hertzler Ranch* Hydraulic Capacity

Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered; Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground); Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond

Stillwater tailings impoundment waters volume	35 MG	600 gpm (24 hr)	rate to dewater Stillwater tailings impoundment
number of days to dewater Stillwater tailings Impoundment	41 days	400 gpm (24 hr)	Stillwater Mine west side adit flow rate at closure
Hertzler Ranch tailings impoundment waters volume	45 MG	396 gpm (24 hr)	rate to dewater Hertzler Ranch tailings impoundment
number of days to dewater Hertzler Ranch tailings Impoundment	79 days	375 gpm (24 hr)	**Days 1-41**: rate to dewater Hertzler Ranch LAD storage pond (Stillwater tailings waters, west side adit waters, plus stored waters) based on LAD capacity
Hertzler Ranch LAD storage pond initial stored volume, Day 1	100 MG	579 gpm (24 hr)	**Days 42-90**: rate to dewater Hertzler Ranch LAD storage pond (west side adit water, stored waters, plus Hertzler Ranch tailings waters) based on LAD capacity

volume in Hertzler Ranch LAD storage pond on Day 42	78 MG	1,375 gpm (24 hr)	**Days 91-120**: rate to dewater Hertzler Ranch LAD storage pond (stored waters plus Hertzler Ranch tailings waters) based on LAD capacity
volume in Hertzler Ranch LAD storage pond on Day 91	38 MG	48 days	number of days adit water is routed to Hertzler Ranch LAD pond after dewatering Stillwater impoundment
Water entering Hertzler Ranch LAD storage pond **Days 1-41**	192,513 ft^3	1,000 gpm (24 hr)	west side adit water and Stillwater tailings waters
Water entering Hertzler Ranch LAD storage pond **Days 42-90**	153,158 ft^3	796 gpm (24 hr)	west side adit water and Hertzler Ranch tailings waters
daily maximum LAD design capacity rate Days 1-120	2,750 gpm (12 hr)	1,375 gpm (24 hr)	maximum application rate at Hertzler Ranch LAD to achieve 80% TIN treatment efficiency

The hydraulic load of 400 gpm treated west side adit water, 250 gpm Stillwater tailings impoundment waters, 396 gpm Hertzler Ranch tailings waters, and stored Hertzler Ranch LAD storage pond waters may be managed at Hertzler Ranch in one season unless potential problems such as high precipitation year, unexpected closure, etc. occur.

Input parameters and assumptions for TDS calculations at Hertzler Ranch		**Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered**	
concentration of TDS in ambient ground water (HMW-4)	150 mg/L	234 µmhos/cm	SMC Monitoring Reports
highest concentration of TDS in Hertlzer Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	1,317 mg/L	2,054 µmhos/cm	concentration of mixed Hertzler Ranch LAD storage pond water (treated adit water, treated Stillwater tailings waters, untreated Hertzler Ranch tailings waters)
concentration of TDS in upper and lower Hertzler Ranch LAD discharge, **Days 1-41:** $\mathbf{C_2, C_3}$	1,137 mg/L	1,774 µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
concentration of TDS in upper and lower Hertzler Ranch LAD discharge, **Days 42-90:** $\mathbf{C_2, C_3}$	1,516 mg/L	2,365 µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
concentration of TDS in upper and lower Hertzler Ranch LAD discharge, **Days 91-120:** $\mathbf{C_2, C_3}$	1,883 mg/L	2,937 µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
concentration of TDS in Hertzler Ranch tailings Impoundment liner leakage, $\mathbf{C_4}$	1,870 mg/L	2,917 µmhos/cm	concentration of TDS in both tailings impoundments: Stillwater and Hertzler Ranch
volume upper Hertzler Ranch LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807 ft^3/d	1,600 gpm (12 hr)	application rate of upper LAD, pers. comm. R Weimer 2009
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193 ft^3/d	33,690 ft^3/d	P1; 350 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193 ft^3/d	38,503 ft^3/d	P2: 400 gpm for 12 hour application rate
volume lower Hertzler Ranch LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487 ft^3/d	81,818 ft^3/d	P3; 850 gpm for 12 hour application rate
total TDS load disposed at Hertzler Ranch during closure	**1,869,440** lbs	43,316 ft^3/d	P4, P5; 450 gpm for 12 hour application rate
average daily TDS load disposed at closure at Hertzler Ranch LAD	**16,995** lbs/day	24,064 ft^3/d	P6; 250 gpm for 12 hour application rate
Annual TDS load per acre per year	**7,081** lbs/ac/yr	264 ac	area of upper and lower LAD
annual TDS load per square foot per year	**0.2** lbs/ft2/yr	110 days	length of closure

Ground Water EC at Hertzler Ranch days 1-41			Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered
ground water concentration area Z_1	424 mg/L	662 µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area Z_2	668 mg/L	1,042 µmhos/cm	loading calculation for Ground Water zone Z_2
ground water concentration area Z_4	1,593 mg/L	2,485 µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
ground water concentration in Z_3 at compliance point HMW-10	383 mg/L	**597** µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, **at compliance point HMW-10** from 1992 Hertzler Ranch EIS
concentration in Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4)	424 mg/L	662 µmhos/cm	ground water concentration prior to discharge to Stillwater River

For this scenario days 1-41, the EC in ground water at the compliance point (Hertzler Ranch LAD) meets the 1,000 µmhos/cm Class I Beneficial Use criterion.

Stillwater River TDS concentration below Hertzler Ranch days 1-41			Days 1-41: Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	44 mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, Q_d	669,071 ft^3/d	7.7 cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, C_d	424 mg/L	662 µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**120 mg/L**	187 µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow

For this scenario days 1-41, the TDS concentration in the Stillwater River below the Hertzler Ranch LAD is less than 250 mg/L recommendation to protect trout eggs.

Ground Water EC at Hertzler Ranch days 42-90			Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground);
ground water concentration area Z_1	424 mg/L	662 µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area Z_2	867 mg/L	1,353 µmhos/cm	loading calculation for Ground Water zone Z_2
ground water concentration area Z_4	1,593 mg/L	2,485 µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
ground water concentration in Z_3 at compliance point HMW-10	598 mg/L	**934** µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, **at compliance point HMW-10** from 1992 Hertzler Ranch EIS
concentration in Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4)	529 mg/L	826 µmhos/cm	ground water concentration prior to discharge to Stillwater River

For this scenario days 42-90, the EC in ground water at the compliance point (Hertzler Ranch LAD) meets the 1,000 µmhos/cm Class I Beneficial Use criterion.

Stillwater River TDS concentration below Hertzler Ranch days 42-90			Days 42-90: Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 90 (routed underground)
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	44 mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, Q_d	669,071 ft^3/d	7.7 cfs	discharge volume in cubic feet per second
discharge concentration to Stillwater River, C_d	529 mg/L	826 µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**140 mg/L**	219 µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow

For this scenario days 42-90, the TDS concentration in the Stillwater River below the Hertzler Ranch is less than 250 mg/L recommendation to protect trout eggs.

Ground Water EC at Hertzler Ranch days 91-120		Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond; mixed waters land applied at full hydraulic capacity of Hertzler Ranch LAD	
ground water concentration area Z_1	424 mg/L	662 µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area Z_2	1,060 mg/L	1,653 µmhos/cm	loading calculation for Ground Water zone Z_2
ground water concentration area Z_4	1,593 mg/L	2,485 µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
ground water concentration in Z_3 at compliance point HMW-10	713 mg/L	1,113 µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, **at compliance point HMW-10** from 1992 Hertzler Ranch EIS **does not meet Class I Beneficial Use**
concentration in Z_5 from upgradient sources (Z_1, Z_2, Z_3, Z_4)	631 mg/L	984 µmhos/cm	ground water concentration prior to discharge to Stillwater River

For this scenario days 91 - 120, the EC in ground water at the compliance point (Hertzler Ranch LAD) does not meet the 1,000 µmhos/cm Class I Beneficial Use criterion.

Stillwater River TDS concentration below Hertzler Ranch days 91-120		Days 91-120: untreated Hertzler tailings waters routed to Hertzler Ranch LAD storage pond; mixed waters land applied at full hydraulic capacity of Hertzler Ranch LAD	
receiving streamflow, Q_s	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, C_s	44 mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, Q_d	2,700,264 ft^3/d	31.3 cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, C_d	631 mg/L	984 µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**338 mg/L**	527 µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow

For this scenario days 91-120, the TDS concentration in the Stillwater River below Hertzler Ranch LAD is greater than the 250 mg/L recommendation to protect trout eggs. To prevent these temporary salts exceedances, the remaining tailings impoundment waters pumped to the pond from days 91-120 with the remaining 38 MG of stored waters in the Hertzler LAD storage pond could winter in the pond and be land applied the following LAD season.

Agency-Mitigated Alternative 3A Option 2, 650 gpm - Stillwater Mine First Season, Days 1: The 250 gpm of untreated east side adit water would be percolated in the east side percolation ponds. *From day 91 on,* the untreated east side adit water would be routed to the underground workings. *FIRST SEASON. Stillwater Mine. Days 1-41*: untreated east side adit waters (250 gpm) percolated in east side percolation ponds; west side adit water (400 gpm) plus Stillwater tailings waters (600 gpm) would be treated in BTS; 716 gpm routed to east side percolation ponds; 284 gpm routed to Hertzler Ranch LAD storage pond. Days 42-120: treated west side adit water (400 gpm) routed to Hertzler Ranch LAD storage pond. Beginning day 120, all west side adit water would be routed underground, unless needed to maintain microbes in the BTS through the second season. *FIRST SEASON Hertzler Ranch. Days 1-41:* The 400 gpm of treated west side adit water would be mixed and treated with 600 gpm of Stillwater tailings waters and 716
gpm routed to Hertzler Ranch LAD storage pond containing 100 MG of treated adit water. Days 42-120: Up to 396 gpm of untreated Hertzler Ranch tailings waters would be routed with 400 gpm of treated west side adit water to the 100 MG of treated adit water in the Hertzler Ranch LAD storage pond and the mixed adit and tailings waters would be land applied at the Hertzler Ranch. *From Days 91 to 120*, water remaining in the Hertzler Ranch LAD storage pond would be land applied at maximum hydraulic capacity. *Day 120,* the 400 gpm untreated west side adit water would be routed underground. *SECOND LAD SEASON Hertzler Ranch.* The excess water that could not be disposed the first year would be land applied at Hertzler Ranch the second LAD season.

volume of 250 gpm in cubic feet per day	48,128 ft^3/d	**250** gpm (24 hr)	untreated east side adit flow rate at closure
volume of 1000 gpm in cubic feet per day	192,513 ft^3/d	250 mg/L	average 2004-2008 Stillwater east side adit TDS concentration
calculated median Stillwater EC west side adit water concentration, from SMC TDS Monitoring Data	766 µmhos/cm	**400** gpm (24 hr)	Stillwater Mine treated west side adit flow rate at closure
average 2004-2008 Stillwater east side adit EC (calculated)	390 µmhos/cm	491 mg/L	median Stillwater TDS west side adit water concentration, SMC Monitoring Data
EC in both tailings impoundments: Stillwater and Hertzler Ranch	2,917 µmhos/cm	600 gpm (24 hr)	Stillwater tailings impoundment pumping rate at closure
calculated EC in mixed west side adit plus Stillwater tailings waters	2,057 µmhos/cm	1,870 mg/L	concentration of TDS in both tailings impoundments: Stillwater and Hertzler Ranch
Days 1-41: EC mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing	949 µmhos/cm	396 gpm (24 hr)	rate to dewater Hertzler Ranch Tailings Impoundment
weighted TDS concentration in mixed west side adit plus **Stillwater tailings waters**	1,318 mg/L	491 mg/L	TDS concentration of **Hertzler Ranch LAD storage pond** prior to dewatering tailings impoundments

Days 1-41: TDS concentration of mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing	609 mg/L	949 µmhos/cm	**Days 1-41:** EC of mixed Hertzler Ranch LAD storage pond water with treated adit water plus treated Stillwater tailings waters**;** assumes instantaneous mixing
Days 42-120: TDS concentration of remaining mixed west side adit water, Hertzler Ranch LAD storage pond water, plus Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes	913 mg/L	1,425 µmhos/cm	**Days 42-120:** EC of remaining mixed Hertzler Ranch LAD storage pond water with adit and Hertzler Ranch tailings waters; assumes instantaneous mixing of total volumes
FIRST SEASON *Hertzler Ranch* Hydraulic Capacity		**Days 1-41: 284 gpm of mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered; Days 42-120: 400 gpm treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters and stored waters.**	
Stillwater tailings impoundment waters volume	35 MG	600 gpm (24 hr)	rate to dewater Stillwater tailings impoundment
number of days to dewater Stillwater tailings Impoundment	41 days	400 gpm (24 hr)	Stillwater Mine west side adit flow rate at closure
Hertzler Ranch tailings impoundment waters volume	45 MG	396 gpm (24 hr)	rate to dewater Hertzler Ranch tailings impoundment
number of days to dewater Hertzler Ranch tailings Impoundment	79 days	375 gpm (24 hr)	**Days 1-41**: rate to dewater Hertzler Ranch LAD storage pond (Stillwater tailings waters, west side adit waters, plus stored waters) based on LAD capacity
Hertzler Ranch LAD storage pond initial stored volume, Day 1	100 MG	579 gpm (24 hr)	**Days 42-120**: rate to dewater Hertzler Ranch LAD storage pond (west side adit water, stored waters, plus Hertzler Ranch tailings waters) based on LAD capacity
volume in Hertzler Ranch LAD storage pond on Day 42	78 MG	1,375 gpm (24 hr)	**Days 91-120**: rate to dewater Hertzler Ranch LAD storage pond (stored waters plus adit and Hertzler Ranch tailings waters) based on LAD capacity
volume in Hertzler Ranch LAD storage pond on Day 91	42 MG	**1.2** MG	volume in Hertzler Ranch LAD storage pond on Day 120
Water entering Hertzler Ranch LAD storage pond **Days 1-41**	192,513 ft^3	1,000 gpm (24 hr)	west side adit water and Stillwater tailings waters
Water entering Hertzler Ranch LAD storage pond **Days 42-120**	153,158 ft^3	796 gpm (24 hr)	west side adit water and Hertzler Ranch tailings waters
daily maximum LAD design capacity rate Days 1-120	264,706 ft^3	1,375 gpm (24 hr)	maximum application rate at Hertzler Ranch LAD to achieve 80% TIN treatment efficiency

The phased hydraulic load of 284 gpm treated west side adit plus Stillwater tailings impoundment waters with stored Hertzler Ranch LAD storage pond waters can be land applied days 1-41, and 400 gpm treated west side adit waters plus 396 gpm Hertzler Ranch tailings waters, with stored Hertzler Ranch LAD storage pond waters may be managed at Hertzler Ranch in one season (days 42-120) unless potential problems such as high precipitation year, etc. occur. 1.2 MG would remain the LAD storage pond for disposal the second LAD season.

Input parameters and assumptions for TDS calculations at Hertzler Ranch			**Days 1-41: 284 gpm of mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered; Days 42-120: 400 gpm treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters and stored waters.**		
concentration of TDS in ambient ground water (HMW-4)	150	mg/L	234	µmhos/cm	SMC Monitoring Reports
highest concentration of TDS in Hertlzer Ranch LAD storage pond liner leakage, $\mathbf{C_1}$	913	mg/L	1,425	µmhos/cm	concentration of mixed Hertzler Ranch LAD storage pond water (treated adit water, treated Stillwater tailings waters, untreated Hertzler Ranch tailings waters)
concentration of TDS in upper and lower Hertzler Ranch LAD discharge, **Days 1-41:** $\mathbf{C_2, C_3}$	870	mg/L	1,358	µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
concentration of TDS in upper and lower Hertzler Ranch LAD discharge, **Days 42-120:** $\mathbf{C_2, C_3}$	1,306	mg/L	2,038	µmhos/cm	concentrated to account for evaporation; no TDS credit for plant uptake
concentration of TDS in Hertzler Ranch tailings Impoundment liner leakage, $\mathbf{C_4}$	1,870	mg/L	2,917	µmhos/cm	concentration of TDS in both tailings impoundments: Stillwater and Hertzler Ranch
volume upper Hertzler Ranch LAD Discharge; P1, P2, P3; assume 30% evaporates, $\mathbf{V_2}$	107,807	ft^3/d	1,600	gpm (12 hr)	application rate of upper LAD, pers. comm. R Weimer 2009
volume of Hertzler Ranch tailings impoundment liner leakage (1 gpm), $\mathbf{V_4}$	193	ft^3/d	33,690	ft^3/d	P1; 350 gpm for 12 hour application rate
volume of Hertzler Ranch LAD storage pond liner leakage (1 gpm), $\mathbf{V_1}$	193	ft^3/d	38,503	ft^3/d	P2: 400 gpm for 12 hour application rate
volume lower Hertzler Ranch LAD discharge: P4, P5, P6 assume 30% evaporates, $\mathbf{V_3}$	77,487	ft^3/d	81,818	ft^3/d	P3; 850 gpm for 12 hour application rate
total TDS load disposed at Hertzler Ranch during closure	**1,869,440**	lbs	43,316	ft^3/d	P4, P5; 450 gpm for 12 hour application rate
average daily TDS load disposed at closure at Hertzler Ranch LAD	**16,995**	lbs/day	24,064	ft^3/d	P6; 250 gpm for 12 hour application rate
Annual TDS load per acre per year	**7,081**	lbs/ac/yr	264	ac	area of upper and lower LAD
Annual TDS load per square foot per year	**0.2**	lbs/ft2/yr	110	days	length of closure

Ground Water TDS concentrations at Hertzler Ranch days 1-41			**Days 1-41: 284 gpm Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered**		
ground water concentration area $\mathbf{Z_1}$	330	mg/L	514	µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area $\mathbf{Z_2}$	528	mg/L	824	µmhos/cm	loading calculation for Ground Water zone Z_2
ground water concentration area $\mathbf{Z_4}$	1,593	mg/L	**2,485**	µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
ground water concentration in $\mathbf{Z_3}$ at compliance point HMW-10	435	mg/L	**679**	µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, **at compliance point HMW-10** from 1992 Hertzler Ranch EIS
concentration in $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1, Z_2, Z_3, Z_4}$)	350	mg/L	546	µmhos/cm	ground water concentration prior to discharge to Stillwater River

For this scenario days 1-41, the EC in ground water at the compliance point (Hertzler Ranch LAD) meets the 1,000 µmhos/cm Class I Beneficial Use criterion.

Stillwater River TDS concentration below Hertzler Ranch days 1-41			**Days 1-41: 284 gpm Mixed treated west side adit plus Stillwater tailings waters routed to Hertzler Ranch LAD storage pond until impoundment dewatered**		
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2	cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, $\mathbf{C_s}$	44	mg/L	69	µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, $\mathbf{Q_d}$	669,071	ft^3/d	7.7	cfs	ground water discharge volume in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	350	mg/L	546	µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**105**	**mg/L**	164	µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow

For this scenario days 1-41, the TDS concentration in the Stillwater River below the Hertzler Ranch LAD is less than 250 mg/L recommendation to protect trout eggs.

Ground Water TDS concentrations at Hertzler Ranch days 42-120		**Days 42-120: 400 gpm Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 120 (routed underground);**	
ground water concentration area $\mathbf{Z_1}$	330 mg/L	514 µmhos/cm	loading calculation for Ground Water zone Z_1
ground water concentration area $\mathbf{Z_2}$	757 mg/L	1,181 µmhos/cm	loading calculation for Ground Water zone Z_2
ground water concentration area $\mathbf{Z_4}$	1,593 mg/L	2,485 µmhos/cm	loading calculation for Ground Water zone Z_4; **does not meet Class I Beneficial Use**
ground water concentration in $\mathbf{Z_3}$ at compliance point HMW-10	607 mg/L	**947** µmhos/cm	cumulative loading calculation for Ground Water zone Z_3, **at compliance point HMW-10** from 1992 Hertzler Ranch EIS
concentration in $\mathbf{Z_5}$ from upgradient sources ($\mathbf{Z_1}$, $\mathbf{Z_2}$, $\mathbf{Z_3}$, $\mathbf{Z_4}$)	471 mg/L	735 µmhos/cm	ground water concentration prior to discharge to Stillwater River
For this scenario days 42-90, the EC in ground water at the compliance point (Hertzler Ranch LAD) meets the 1,000 µmhos/cm Class I Beneficial Use criterion.			
Stillwater River TDS concentration below Hertzler Ranch days 42-120		**Days 42-120: 400 gpm Treated west side adit waters routed to Hertzler Ranch LAD storage pond to be mixed with untreated Hertzler Tailings waters; no adit water after day 120 (routed underground)**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680 ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, $\mathbf{C_s}$	44 mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
ground water discharge volume, $\mathbf{Q_d}$	669,071 ft^3/d	7.7 cfs	discharge volume in cubic feet per second
discharge concentration to Stillwater River, $\mathbf{C_d}$	471 mg/L	735 µmhos/cm	ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**129 mg/L**	201 µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow
For this scenario days 42-90, the TDS concentration in the Stillwater River is less than 250 mg/L recommendation to protect trout eggs.			
Ground Water Salts Calculation Input Parameters for the Stillwater Mine Days 1-90		**Days 1-41: 250 gpm untreated east-side adit water and 716 gpm treated west-side adit plus treated Stillwater tailings waters would be routed to Stillwater Mine east-side and Stillwater Valley Ranch percolation ponds. Days 42-90: 250 gpm untreated east-side adit water would be routed to the east-side percolation ponds. On day 91, the east-side adit water would be routed underground. Days 91-120 the 400 gpm west-side adit water would be routed to the Hertzler Ranch LAD. On day 121, the 400 gpm west-side adit water would be routed underground.**	
depth of aquifer, **D**	15 ft	**250** gpm (24 hr)	untreated east side adit flow rate at closure
hydraulic conductivity east side percolation ponds, $\mathbf{k_{SVR}}$	4,076 ft/day	250 mg/L	average 2004-2008 Stillwater east side adit TDS concentration
hydraulic conductivity east side percolation ponds, $\mathbf{k_E}$	539 ft/day	48,128 ft^3/d	volume of untreated east-side adit water percolated at closure
gradient, **i**	0.006 ft/ft	716 gpm (24 hr)	treated adit plus Stillwater tailings waters percolated at Stillwater Mine
length of mixing zone, $\mathbf{L_{SVR}}$	500 ft	137,840 ft^3/d	volume of treated adit plus tailings waters percolated at closure
width of mixing zone at downgradient extent, $\mathbf{W_{SVR}}$	507 ft	609 mg/L	TDS of treated adit plus Stillwater tailings waters percolated at Stillwater Mine
length of mixing zone, $\mathbf{L_E}$	2,000 ft		2008 MPDES Permit page 4
width of mixing zone at downgradient extent, $\mathbf{W_E}$	650 ft		2008 MPDES Permit page 4
cross sectional area of aquifer, $\mathbf{A_{SVR}}$	7,605 ft		D * W, allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_E}$	9,750 ft		D * W, allowed by 17.30.517(d)
$\mathbf{Q_{SVR}=k_{SVR}iA_{SVR}}$, ground water available for mixing	185,988 ft^3/d		calculation per 17.30.517(d)
$\mathbf{Q_E=k_EiA_E}$, ground water available for mixing	31,532 ft^3/d		calculation per 17.30.517(d)
ambient TDS concentration in ground water at MW-10A Stillwater Mine	81 mg/L	126 µmhos/cm	median concentration of TDS in ambient ground water at SMC MW-10A
ground water TDS concentration at end of Stillwater **east side percolation pond** mixing zone	306 mg/L	**477** µmhos/cm	weighted concentration of TDS from percolation of 716 gpm west side adit and Stillwater tailings waters with 250 gpm east side adit waters
ground water TDS concentration at end of **Stillwater Valley Ranch percolation pond** mixing zone	173 mg/L	**270** µmhos/cm	**cumulative concentration** of TDS from percolation of east side adit waters plus 716 gpm west side adit plus tailings waters measured at the end of the Stillwater Valley Ranch mixing zone

Stillwater River TDS concentration at Stillwater Mine days 1-90			**Days 1-41: 250 gpm untreated east-side adit water and 716 gpm treated west-side adit plus treated Stillwater tailings waters would be routed to Stillwater Mine east-side and Stillwater Valley Ranch percolation ponds. Days 42-90: 250 gpm untreated east-side adit water would be routed to the east-side percolation ponds. On day 91, the east-side adit water would be routed underground. Days 91-120 the 400 gpm west-side adit water would be routed to the Hertzler Ranch LAD. On day 121, the 400 gpm west-side adit water would be routed underground.**	
receiving streamflow, $\mathbf{Q_s}$	2,695,680	ft^3/d	31.2 cfs	7Q10 at mine site 31.2 cfs
receiving stream ambient concentration, $\mathbf{C_s}$	44	mg/L	69 µmhos/cm	median concentration at Hertzler Ranch SMC-12, SMC monitoring data
weighted average ground water discharge volume, $\mathbf{Q_d}$	328,441	ft^3/d	3.8 cfs	weighted average ground water discharge volume in cubic feet per second
ground water concentration prior to discharge to Stillwater River, $\mathbf{C_d}$	173	mg/L	270 µmhos/cm	weighted average ground water concentration prior to discharge to Stillwater River
Stillwater River concentration	**58**	**mg/L**	90 µmhos/cm	actual concentration at Hertzler Ranch SMC-13 would be less; higher streamflow

Spreadsheet 1B 1C Nitrogen: East Boulder Mine Alternative 1B and Boe Ranch LAD System Alternative 1C No Action Closure Nitrogen Analyses

Per SMC 1998, preferential disposal of treated adit waters is at the mine LAD areas and percolation pond. The Boe Ranch LAD system would not be built. For the East Boulder Mine, the assumptions for these calculations have been made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding ground and surface water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer (no unsaturated zone was considered). To determine the concentration of total inorganic nitrogen (TIN) in ground water, it was assumed that all ground water flow parallels the East Boulder River and enters the river at a point at, or just downstream of, the permit boundary (EBR-004/4a). Tailings impoundment waters would be evaporated over the tailings mass and would not discharge to ground water. The nitrogen concentration of treated adit water will vary with flow rate. The calculations allow nitrogen treatment credit for snowmaking, evaporation, and plant uptake, but no treatment credit is given for percolation. The design capacities/assumed efficiencies are as follows:
the PoleCat evaporators in summer 30% evaporation, center pivots 30%; PoleCat snowmakers in winter 30% evaporation. The East Boulder Mine is permitted to discharge an average of 30 lbs/day total inorganic nitrogen into the East Boulder River. The existing treatment systems would be increased to meet hydraulic and nitrogen treatment requirements. All waters are treated prior to discharge. The MPDES permit nitrogen limit of 30 lbs/day is after all treatment (BTS/Anox, snowmaking, evaporation, plant uptake). These analyses assume a 1,000 gpm treatment capacity for the BTS/Anox system. The total inorganic nitrogen concentration in spring SP-11 is representative of ground water downgradient of the percolation pond.

No Action Alternative 1B and 1C Closure Option 1, 737 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at the East Boulder Mine LAD Areas 2, 3-Upper, 4 and 6. The Boe Ranch LAD system would not be built.

East Boulder MPDES Permit Source-Specific (percolation pond) mixing zone input values			**20** lbs/day	East Boulder historical maximum nitrogen load post BTS/Anox treatment
			737 gpm (24 hr)	East Boulder adit flow rate at closure (24 hr rate)
			2.3 mg/L	treated concentration of East Boulder adit waters based on MPDES 30 lbs/day limit
depth of aquifer, **D**	80	ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385	ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, $\mathbf{L_1}$	3,600	ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3			MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm		MPDES Statement of Basis, p. 25-26
upgradient ambient concentration of notrogen in ground water (WW-1), $\mathbf{C_A}$	0.1	mg/L		median value SMC Monitoring Data 2004-2008
angle of dispersion	0.087421693	tan 5°		allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2		D * W, allowed by 17.30.517(d)
70% of available Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	76,955	ft^3/d		calculation per 17.30.517(d); MPDES statement of basis, p.25-26
East Boulder Hydraulic Loading Calculations			**737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6; tailings waters evaporated over the tailings mass**	
East Boulder Tailings Impoundment discharge volume	40	MG		volume of water to be discharged to install cover (KP); evaporated over tailings mass
Adit Flow rate	737	gpm (24 hr)	1,474 gpm (12 hr)	Adit flow rate
Summer LAD Area 6 maximum hydraulic load end of pipe	**56,406**	ft^3/d	**586** gpm (12 hr)	evaporator maximum flow rate, 10.2 ac; CES 2008
Summer LAD Area 4 maximum hydraulic load end of pipe	26,952	ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.2 ac; CES 2008
Summer LAD Area 3 Upper maximum hydraulic load end of pipe	26,952	ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.3 ac; CES 2008
Summer LAD Area 2 maximum hydraulic load end of pipe	29,262	ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac; CES 2008

Summer maximum hydraulic load end of pipe for LAD areas 2, 3-Upper, 4, 6	**139,572** ft^3/d	**1,450** gpm (12 hr)	total rate for all units
additional volume of water needing disposal in Summer	**12** gpm (24 hr)	**24** gpm (12 hr)	
Insufficient pond storage capacity exists at the Easat Bouler Mine for this adit flow rate. Approximately 1.1 MG is generated in 24 hours, the available storage is 0.7 MG, and the 12 hour summer LAD disposal is 1.0 MG). About 0.02 MG excess water must be percolated if it is to be handled solely at the East Boulder Mine.			
Winter LAD Area 6 snowmaking maximum hydraulic load end of pipe	39,465 ft^3/d	**410** gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac; CES 2008
Winter LAD Area 4 snowmaking maximum hydraulic load end of pipe	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac; CES 2008
Winter LAD Area 3 Upper snowmaking maximum hydraulic load end of pipe	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate, 11.3 ac; CES 2008
Winter maximum snowmaking hydraulic load end of pipe, LAD areas 3 Upper, 4, 6	**54,866** ft^3/d	**570** gpm (12 hr)	total rate for all units
additional volume of water needing disposal in Winter	**452** gpm (24 hr)	**904** gpm (12 hr)	
Insufficient pond storage capacity exists at the Easat Bouler Mine for this adit flow rate. Approximately 1.1 MG is generated in 24 hours, the available storage is 0.7 MG, and the 12 hour summer LAD disposal is 1.0 MG). About 0.3 MG excess water must be percolated if it is to be handled solely at the East Boulder Mine.			
No Action Alternative 1B and 1C Closure Option 2, 737 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at the East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6 and the excess adit water would be percolated at the mine site. The Boe Ranch LAD system would not be built.			
Summer LAD nitrogen load East Boulder Mine, LAD areas 2, 3, 4, 6	**3.9** lbs/day	2.3 mg/L	nitrogen concentration of treated adit waters
LAD Area 6 flow rate (30% hydraulic evaporation, 80% nitrogen credit)	39,484 ft^3/d	**1.6** lbs/day	evaporator maximum flow rate, 10.2 ac; CES 2008
LAD Area 4 flow rate (30% hydraulic evaporation, 80% nitrogen credit)	18,866 ft^3/d	**0.8** lbs/day	evaporator maximum flow rate, 11.2 ac; CES 2008
LAD Area 3 Upper flow rate (30% hydraulic evaporation, 80% nitrogen credit)	18,866 ft^3/d	**0.8** lbs/day	evaporator maximum flow rate, 11.3 ac; CES 2008
LAD Area 2 flow rate (30% hydraulic evaporation, 80% nitrogen credit) center pivot	20,483 ft^3/d	**0.8** lbs/day	center pivot maximum flow rate, 13.9 ac; CES 2008
Daily Summer nitrogen load to percolation (no nitrogen credit)	**0.2** lbs/day	0.6 mg/L	nitrogen concentration of applied waters with 30% evaporation applied and post-LAD credit
Daily Summer LAD nitrogen load (post-plant uptake) plus percolation (no nitrogen credit)	**4.1** lbs/day		nitrogen load of LAD plus percolated waters
Total Summer LAD nitrogen Load/ac	**10.1** lbs/ac/yr	120 days	time LAD applied (length of LAD season)
Total Summer nitrogen Load (percolation plus LAD) days 1-120	**472** lbs	46.6 ac	area of LAD
Winter Snowmaking East Boulder Mine site, nitrogen load LAD areas 3, 4, 6	**1.5** lbs/day	2.3 mg/L	nitrogen concentration of mixed waters
LAD Area 6 snowmaking rate (30% hydraulic evaporation, 80% nitrogen credit)	27,626 ft^3/d	**1.1** lbs/day	snowmaker maximum flow rate, 10.2 ac; CES 2008
LAD Area 4 snowmaking rate (30% hydraulic evaporation, 80% nitrogen credit)	5,390 ft^3/d	**0.2** lbs/day	snowmaker maximum flow rate, 11.2 ac; CES 2008
LAD Area 3 snowmaking rate (30% hydraulic evaporation, 80% nitrogen credit)	5,390 ft^3/d	**0.2** lbs/day	snowmaker maximum flow rate, 11.3 ac; CES 2008
Daily Winter nitrogen load to percolation (no nitrogen credit)	**12.3** lbs/day		daily percolation nitrogen load
Daily Winter LAD nitrogen load (post snowmaking plus percolation no nitrogen credit)	**13.8** lbs/day		daily snowmaking and percolation nitrogen load
Daily Winter LAD nitrogen load applied per acre	**0.0** lbs/ac/yr	120 days	time LAD applied (length of LAD season)
Total Winter nitrogen load (percolation plus snowmaking) days 1-120	**1,658** lbs	32.7 ac	area of snowmaking LAD
Percolation nitrogen load days 121-365	**20** lbs/day	**4,900** lbs	**Total percolation nitrogen load after LAD and snowmaking, days 121-365**

Ground Water Inputs Below East Boulder Mine LAD area at Closure		737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6; tailings waters evaporated over the tailings mass	
depth of aquifer, D_2	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, L_2	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of zone, W_2	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_2	14,303 ft^2		D * W, allowed by 17.30.517(d)
70% of available volume of ground water available for mixing Q_1=kiA	76,955 ft^3/d	400 gpm (24 hr)	calculation per 17.30.517(d); MPDES statement of basis, p.25-26
Volume of ground water available for mixing (under LAD) Q_2=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d); ground water flowing beneath LAD area
concentration of nitrogen in adit waters	2.3 mg/L	0.6 mg/L	Summer nitrogen concentration in LAD waters, post plant uptake, 30% evaporation
upgradient ambient concentration of nitrogen in ground water (WW-1), C_A	0.1 mg/L	0.6 mg/L	Winter nitrogen concentration in LAD waters, post snowmaking, 30% evaporation
Volume of water: **summer LAD**, V_{sL}	195,401 ft^3/d	1,015 gpm (24 hr)	summer volume adit water from LAD areas 2, 3, 4, 6 with evaporation taken
Volume of water: **summer percolation**, V_{sP}	2,310 ft^3/d	12 gpm (24 hr)	summer volume of adit water requiring percolation
Volume of water: **winter snowmaking**, V_{Ws}	38,406 ft^3/d	200 gpm (24 hr)	winter volume adit water from LAD areas 3, 4, 6 with snowmaking credit
Volume of water **percolated in winter**, V_{Wp}	87,016 ft^3/d	452 gpm (24 hr)	winter volume of adit water requiring percolation
projected summer concentration of nitrogen in ground water days 1-120, Z_s	**0.5 mg/L**		summer concentration of nitrogen in ground water near SP-11
projected winter concentration of nitrogen in ground water days 1-120, Z_W	**1.0 mg/L**		winter concentration of nitrogen in ground water near SP-11
The total inorganic nitrogen concentration in ground water is less than the DEQ-7 ground water criterion of 10 mg/L.			

East Boulder River Concentration below LAD area at Closure		737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6; tailings waters evaporated over the tailings mass	
receiving streamflow, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, C_s	0.1 mg/L		actual concentration at EBR-001, SMC monitoring data
summer ground water discharge volume, Q_{dS}	302,557 ft^3/d	3.5 cfs	credit for evaporative losses taken in volume calculations
winter ground water discharge volume, Q_{dW}	230,268 ft^3/d	2.7 cfs	credit for evaporative losses taken in volume calculations
summer ground water discharge concentration to East Boulder River, C_{dS}	0.5 mg/L		based on summer concentration of ground water at end of mixing zone
winter ground water discharge concentration to East Boulder River, C_{dW}	1.0 mg/L		based on winter concentration of ground water at end of mixing zone
projected Summer East Boulder River nitrogen concentration (5.0 cfs 7Q10)	**0.2 mg/L**		calculated concentration at 7Q10 low flow
projected Winter East Boulder River nitrogen concentration (5.0 cfs 7Q10)	**0.4 mg/L**		calculated concentration at 7Q10 low flow
The total inorganic nitrogen concentration in the East Boulder River is less than 1.0 mg/L.			

No Action Alternative 1B and 1C Closure Option 1, 150 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at the East Boulder Mine LAD Area 6. The Boe Ranch LAD system would not be built.

			20	lbs/day	East Boulder historical maximum nitrogen load post BTS/Anox treatment
East Boulder MPDES Permit Source-Specific (percolation pond) mixing input values			**150**	gpm (24 hr)	East Boulder adit flow rate at closure (24 hr rate)
			11.1	mg/L	treated concentration of East Boulder adit waters based on MPDES 20 lbs/day limit
depth of aquifer, **D**	80	ft			MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385	ft			MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, $\mathbf{L_1}$	3600	ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm (24 hr)			MPDES Statement of Basis, p. 25-26
upgradient ambient concentration of nitrogen in ground water (WW-1), $\mathbf{C_A}$	0.06	mg/L			median value SMC Monitoring Data 1989-2008
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	76,955	ft^3/d	400	gpm (24 hr)	calculation per 17.30.517(d); MPDES statement of basis, p.25-26
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d); ground water flowing beneath LAD area
East Boulder Hydraulic Loading Calculations					Design flow for evaporators, snowmakers, center pivot from KP 2000; acreage from CES 2008
Adit Flow rate	**150**	gpm (24 hr)	**300**	gpm (12 hr)	Adit flow rate
Summer LAD Area 6 maximum hydraulic load end of pipe	56,406	ft^3/d	**586**	gpm (12 hr)	evaporator max flow rate, 10.2 ac; CES 2008
Winter LAD Area 6 snowmaking maximum hydraulic load end of pipe	39,465	ft^3/d	**410**	gpm (12 hr)	snowmaker max flow rate, 10.2 ac; CES 2008

The hydraulic capacity of 150 gpm (24 hr) adit water can be managed at East Boulder Mine LAD Area 6 in winter or summer. No percolation is needed.

East Boulder Nitrogen Loading Calculations			28,877	ft^3/d	Adit water volume per day
Adit Flow rate	**150**	gpm (24 hr)	300	gpm (12 hr)	Adit flow rate
Summer nitrogen load to ground water; all waters LAD at Area 6 (30% evaporation, 80% nitrogen credit post-plant uptake)	**4.0**	lbs/day	3.2	mg/L	Summer nitrogen concentration of land applied waters
Summer nitrogen load: all waters percolated	**20.0**	lbs/day	3.2	mg/L	Winter nitrogen concentration of snowmaking waters
Total Summer LAD nitrogen Load	**480**	lbs	120	days	time LAD applied (length of LAD season)
Total Summer LAD nitrogen Load/ac	**47**	lbs/ac/yr	10.2	ac	area of LAD
Winter Snowmaking nitrogen load to ground water, LAD Area 6 (30% hydraulic evaporation, 80% snowmaking nitrogen credit)	**4.0**	lbs/day	11.1	mg/L	treated concentration of East Boulder adit waters based on MPDES permit 20 lbs/day nitrogen limit
Total Winter nitrogen snowmaking load	**480**	lbs/day			
Total Winter Snowmaking nitrogen load/ac	**47**	lbs/ac/yr	**4,900**	lbs	**Total percolation load after LAD and snowmaking, days 121-365**

The total inorganic nitrogen load for percolation and for a combination of percolation and LAD meets the 30 lb/day MPDES permit limit in both summer and winter.

Appendix C
DEQ 2010

Ground Water Inputs Below East Boulder Mine LAD area at Closure		150 gpm treated adit water applied at East Boulder Mine LAD Area 6	
depth of aquifer, $\mathbf{D_2}$	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	76,955 ft^3/d	400 gpm (24 hr)	
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
concentration of nitrogen in adit waters	11.1 mg/L	3.2 mg/L	Summer nitrogen concentration of land applied waters
upgradient concentration of nitrogen in aquifer (WW-1), CA	0.1 mg/L	3.2 mg/L	Winter nitrogen concentration of snowmaking waters
Volume of water applied: **summer LAD** at LAD area 6, $\mathbf{V_s}$	40,428 ft^3/d	210 gpm (24 hr)	summer volume applied at LAD 6; 30% evaporation credit taken; assume full flow
Volume of water applied: **winter snowmaking** at LAD Area 6, $\mathbf{V_{W1}}$	40,428 ft^3/d	210 gpm (24 hr)	winter volume applied at LAD 6; 30% evaporation credit taken; assume full flow
summer concentration of ground water, Z_s	**0.9 mg/L**		projected summer ground water concentration near SP-11
winter concentration of ground water, Z_W	**0.9 mg/L**		projected winter ground water concentration near SP-11

The total inorganic nitrogen concentration in ground water is less than the DEQ-7 ground water quality criterion of 10 mg/L.

East Boulder River Concentration below LAD area at Closure		150 gpm treated adit water applied at East Boulder Mine LAD Area 6	
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	0.1 mg/L		MPDES Statement of Basis page 24
summerdischarge volume through aquifer, $\mathbf{Q_{ds}}$	145,273 ft^3/d	1.7 cfs	credit for evaporative losses taken in volume calculations
winter discharge volume through aquifer, $\mathbf{Q_{dw}}$	145,273 ft^3/d	1.7 cfs	credit for evaporative losses taken in volume calculations
summer discharge concentration to East Boulder River, $\mathbf{C_{ds}}$	0.9 mg/L		based on summer concentration of ground water near SP-11
winter discharge concentration to East Boulder River, $\mathbf{C_{dw}}$	0.9 mg/L		based on winter concentration of ground water near SP-11
Summer East Boulder River nitrogen concentration (5.0 cfs 7Q10)	**0.3 mg/L**		calculated concentration at 7Q10 low flow
Winter East Boulder River nitrogen concentration (5.0 cfs 7Q10)	**0.3 mg/L**		calculated concentration at 7Q10 low flow

The total inorganic nitrogen concentration in the East Boulder River is less than the MPDES permit limit of 1.0 mg/L.

Spreadsheet 1B 1C Salts: East Boulder Alternative 1B and Boe Ranch Alternative 1C No Action Closure Salinity Analyses

Per SMC 1998, preferential disposal of treated adit waters is at the mine LAD areas and percolation pond; the Boe Ranch LAD system is not built. For the East Boulder Mine, the assumptions for calculations were made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine LAD area, any water that percolates below the root zone is assumed to immediately enter the ground water (no unsaturated zone was considered). To determine the concentration of salts in ground water, it was assumed that all ground water flow parallels the East Boulder River and enters the river at a point at, or just downstream of, the permit boundary (EBR-004/4A). Tailings impoundment waters would be evaporated over the tailings mass and would not discharge to ground water. The salts concentration of treated adit water will not vary with flow rate. The calculations do not allow salts treatment credit for snowmaking, evaporation, plant uptake, or percolation. The design capacities are as follows: PoleCat evaporators assume summer 30% evaporation, center pivots 30%; PoleCat winter 30% evaporation. The East Boulder mine MPDES permit does not set a limit for TDS or EC. The salts load at the East Boulder Mine is calculated from TDS. The ground water beneath the East Boulder mine has a Class I Beneficial Use (up to 1000 µmhos/cm EC). The hydraulic volume calculations allow a water volume reduction (evaporation credit) that has a corresponding increase in TDS concentration.The concentrations of TDS or measured EC at SP-11 (downgradient of the LAD area) are assumed to be representative of the ground water affected by application of mine waters.

No Action Alternative 1B and 1C Closure Option 1, 737 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at East Boulder Mine LAD Areas 2, 3-Upper, 4 and 6. The Boe Ranch LAD system would not be built.

median adit water EC concentration derived from SMC monitoring data 2002-2006	906 µmhos/cm		
median adit TDS concentration derrived from SMC monitoring data 2002-2006	550 mg/L	**737** gpm (24 hr)	adit flow rate at closure
East Boulder MPDES Source-Specific (percolation pond) mixing zone input values			
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, **L_1**	3,600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400 gpm		MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in ground water (WW-1)	106 mg/L	165 µmhos/cm	median value SMC Monitoring Data 1989-2008
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, **W_1**	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, **A_1**	55,977 ft^2		D * W, allowed by 17.30.517(d)
70% of available Volume of Ground Water available for mixing **Q_1**=kiA	76,955 ft^3/d		MPDES Statement of Basis, p. 25-26
East Boulder Hydraulic Loading Calculations		**737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6**	
East Boulder Tailings Impoundment discharge volume	40 MG		volume of water to be discharged to install cover (KP); evaporated over tailings mass
Adit Flow rate	737 gpm (24 hr)	**1,474** gpm (12 hr)	Adit flow rate
Summer LAD Area 6 maximum hydraulic load end of pipe	56,406 ft^3/d	586 gpm (12 hr)	evaporator maximum flow rate, 10.2 ac; CES 2008
Summer LAD Area 4 maximum hydraulic load end of pipe	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.2 ac; CES 2008
Summer LAD Area 3 Upper maximum hydraulic load end of pipe	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.3 ac; CES 2008
Summer LAD Area 2 maximum hydraulic load end of pipe	29,262 ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac; CES 2008
Summer maximum hydraulic load end of pipe, LAD areas 2, 3 Upper, 4, 6	**139,572 ft^3/d**	**1,450** gpm (12 hr)	total rate for all units
excess volume of water needing disposal in Summer	**12** gpm (24 hr)	**24** gpm (12 hr)	volume of water exceeding hydraulic capacity of Summer LAD

Insufficient pond storage capacity exists at this flow rate. Approximately 1.1 MG is generated in 24 hours, the available storage is 0.7 MG, and the 12 hour summer LAD disposal is 1.0 MG. About 0.02 MG excess water must be percolated if handled at East Boulder Mine

Winter LAD Area 6 snowmaking maximum hydraulic load end of pipe	39,465	ft^3/d	410	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac; CES 2008
Winter LAD Area 4 snowmaking maximum hydraulic load end of pipe	7,701	ft^3/d	80	gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac; CES 2008
Winter LAD Area 3 Upper snowmaking maximum hydraulic load end of pipe	7,701	ft^3/d	80	gpm (12 hr)	snowmaker maximum flow rate, 11.3 ac; CES 2008
Winter maximum snowmaking hydraulic load end of pipe, LAD areas 3 Upper, 4, 6	**54,866**	**ft^3/d**	**570**	gpm (12 hr)	total rate for all units
excess volume of water needing disposal in Winter	**452**	gpm (24 hr)	**904**	gpm (12 hr)	volume of water exceeding hydraulic capacity of Winter snowmaking LAD

Insufficient pond storage capacity exists at this flow rate. Approximately 1.1 MG is generated in 24 hours, the available storage is 0.7 MG, and the 12 hour winter snowmaking LAD is 0.4 MG. About 0.3 MG excess water must be percolated if handled at East Boulder Mine

No Action Alternative 1B and 1C Closure Option 2, 737 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6 and the excess adit water would be percolated at the mine site. The Boe Ranch LAD system would not be built.

East Boulder Salt Loading Input Parameters, CLOSURE			**737 gpm treated adit water applied at East Boulder Mine**		
median adit TDS concentration	**550**	mg/L	**786**	mg/L	TDS concentration adit water after 30% evaporation (evaporators Summer LAD)
Adit Flow rate	**737**	gpm (24 hr)	**786**	mg/L	TDS concentration adit water after 30% evaporation (Winter LAD snowmaking)
Daily Summer LAD Salts load East Boulder Mine, LAD areas 2, 3, 4, 6	**4,785**	lbs/day	**737 gpm treated adit water applied at East Boulder Mine Summer LAD Areas 2, 3-Upper, 4, and 6**		
LAD Area 6 flow rate (30% hydraulic evaporation)	56,406	ft^3/d	**1,934**	lbs/day	evaporator maximum flow rate, 10.2 ac; CES 2008
LAD Area 4 flow rate (30% hydraulic evaporation)	26,952	ft^3/d	**924**	lbs/day	evaporator maximum flow rate, 11.2 ac; CES 2008
LAD Area 3 Upper flow rate (30% hydraulic evaporation)	26,952	ft^3/d	**924**	lbs/day	evaporator maximum flow rate, 11.3 ac; CES 2008
LAD Area 2 flow rate center pivot (30% hydraulic evaporation)	29,262	ft^3/d	**1,003**	lbs/day	center pivot maximum flow rate, 13.9 ac; CES 2008
Summer Salts Load to percolation	**9,504**	lbs/yr			
Summer Salts LAD Load	**574,200**	lbs/yr	120	days	time LAD applied (length of LAD season)
Summer Salts LAD Load per acre	**12,322**	lbs/ac/yr	46.6	ac	area of LAD
Summer Salts LAD Load applied per square foot	**0.3**	lbs/ft2/yr			
total Summer Salt Load (LAD plus percolation)	**583,704**	lbs/yr			salt is concentrated by evaporation when land applied
Daily Winter Snowmaking Salts load East Boulder Mine, LAD areas 3, 4, 6	**1,881**	lbs/day	**737 gpm treated adit water applied at East Boulder Mine Winter snowmaking LAD Areas 3-Upper, 4, and 6**		
LAD Area 6 snowmaking rate (30% hydraulic evaporation)	39,465	ft^3/d	**1,353**	lbs/day	snowmaker maximum flow rate, 10.2 ac; CES 2008
LAD Area 4 snowmaking rate (30% hydraulic evaporation)	7,701	ft^3/d	**264**	lbs/day	snowmaker maximum flow rate, 11.2 ac; CES 2008
LAD Area 3 snowmaking rate (30% hydraulic evaporation)	7,701	ft^3/d	**264**	lbs/day	snowmaker maximum flow rate, 11.3 ac; CES 2008
Winter Salts load to percolation	**357,984**	lbs/yr			
Winter Salts LAD load	**225,720**	lbs/yr	120	days	time LAD applied (length of LAD season)
Winter Salts LAD load per acre	**6,903**	lbs/ac/yr	32.7	ac	area of LAD
Winter Salts LAD load per square foot	**0.2**	lbs/ft2/yr	**583,704**	lbs/yr	**Total Winter Salts Load (LAD plus percolation)**

Closure Ground Water Mixing Calculations for East Boulder Mine LAD Area			**737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6**	
depth of aquifer, $\mathbf{D_2}$	15	ft		
hydraulic conductivity, **k**	75	ft/d		allowed by 17.30.517(d)
gradient, **i**	0.026	ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700	ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900	ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693	tan 5°		MPDES Statement of Basis, p. 25-26
width of zone, $\mathbf{W_2}$	954	ft		allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2		width of source + (tan 5 * length) allowed by 17.30.517(d)
70% of available volume of ground water available for mixing $\mathbf{Q_1}$=kiA	76,955	ft^3/d	400 gpm (24 hr)	ground water flowing into LAD from beneath tailings impoundment
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145 gpm (24 hr)	D * W, allowed by 17.30.517(d)
median concentration of salt in adit waters, SMC monitoring data 2002-2006	550	mg/L		calculation per 17.30.517(d)
adit water TDS concentration when LAD in summer (30% hydraulic evaporation)	786	mg/L		all areas 30% evaporation
adit water TDS concentration when LAD in winter (30% hydraulic evaporation)	786	mg/L		all areas 30% evaporation
upgradient concentration of TDS in ground water (WW-1), $\mathbf{C_A}$	106	mg/L		median value SMC Monitoring Data 1989-2008
receiving stream baseline ambient concentration at EBR-001	49	mg/L	76 µmhos/cm	1996-1999 median baseline EC from SMC monitoring data (Hydrometrics 2001)
Volume of water applied: summer LAD, $\mathbf{V_s}$	195,401	ft^3/d	1,015 gpm (12 hr)	Summer adit water volume pumped to LAD areas 2, 3 Upper, 4, 6, minus evaporation
Volume of water: summer percolation, $\mathbf{V_p}$	2,310	ft^3/d	12 gpm (12 hr)	Summer volume from percolation; excess water needing disposal
Volume of water: winter snowmaking, $\mathbf{V_{W1}}$	76,813	ft^3/d	399 gpm (12 hr)	Winter adit water volume from LAD areas 3 Upper, 4, 6, minus evaporation
Winter volume of water applied: percolation, $\mathbf{V_{W2}}$	87,016	ft^3/d	452 gpm (12 hr)	winter volume from percolation; excess water needing disposal
summer concentration of ground water at East Boulder Mine, Z_s	**562**	mg/L	**877** µmhos/cm	projected **summer** concentration of TDS and EC in ground water at SP-11 just prior to discharging to East Boulder River
winter concentration of ground water at East Boulder Mine, Z_W	**460**	mg/L	**718** µmhos/cm	projected **winter** concentration of TDS and EC in ground water at SP-11 just prior to discharging to East Boulder River

The EC in ground water meets the 1,000 µmhos/cm Class I Beneficial Use Criteria during summer LAD and winter snowmaking.

East Boulder River Concentration below LAD area			**737 gpm treated adit water applied at East Boulder Mine LAD Areas 2, 3-Upper, 4, and 6**		
receiving streamflow, $\mathbf{Q_s}$	432,000	ft^3/d	5.0	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
irrigation season receiving streamflow, $\mathbf{Q_s}$	172,800	ft^3/d	2.0	cfs	flow in stream during irrigation season
receiving stream ambient concentration, $\mathbf{C_s}$	45	mg/L			median concentration SMC Monitoring Data 2004-2009
ground water discharge volume, $\mathbf{Q_{ds}}$	302,557	ft^3/d	3.5	cfs	summer discharge volume
ground water discharge volume, $\mathbf{Q_{dw}}$	268,674	ft^3/d	3.1	cfs	winter discharge volume
summer discharge concentration to Stillwater River, $\mathbf{C_{ds}}$	562	mg/L			based on summer concentration of ground water at end of mixing zone
winter discharge concentration to Stillwater River, $\mathbf{C_{dw}}$	460	mg/L			based on winter concentration of ground water at end of mixing zone
Summer East Boulder River TDS concentration (5.0 cfs 7Q10)	**179**	**mg/L**	280	µmhos/cm	calculated concentration at 7Q10 low flow
Winter East Boulder River TDS concentration (5.0 cfs 7Q10)	**171**	**mg/L**	267	µmhos/cm	calculated concentration at 7Q10 low flow

The TDS concentration in the East Boulder River does not exceed the 250 mg/L recommendation protective of trout eggs.

Appendix C
DEQ 2010

No Action Alternative 1B and 1C Closure Option 1, 150 gpm: Tailings waters would be evaporated over the tailings mass. Adit water would be land applied at the East Boulder Mine LAD Area 6. The Boe Ranch LAD system would not be built.

median adit water EC concentration derived from SMC monitoring data	906	μmhos/cm	550	mg/L	median adit TDS concentration derrived from SMC monitoring data
			150	gpm (24 hr)	adit flow rate at closure
East Boulder MPDES Source-Specific (percolation pond) mixing zone input values					
depth of aquifer, **D**	80	ft			MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385	ft			MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, L_1	3,600	ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm (24 hr)			MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in ground water (WW-1), CA	106	mg/L			median value SMC Monitoring Data 1989-2008
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, W_1	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_1	55,977	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing Q_1=kiA	109,156	ft^3/d			calculation per 17.30.517(d); MPDES Statement of Basis, p. 25-26
East Boulder Hydraulic Loading Calculations			**150 gpm treated adit water applied at East Boulder Mine LAD Area 6**		
Adit Flow rate	150	gpm (24 hr)	**300**	gpm (12 hr)	Adit flow rate
Summer LAD Area 6 maximum hydraulic load end of pipe	56,406	ft^3/d	**586**	gpm (12 hr)	evaporator maximum flow rate, 10.2 ac; CES 2008
Winter LAD Area 6 snowmaking maximum hydraulic load end of pipe	39,465	ft^3/d	**410**	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac; CES 2008

The hydraulic capacity of 150 gpm (24 hr) adit water can be managed at East Boulder Mine via LAD in winter or summer.

East Boulder Salt Loading Input Parameters, closure			**150 gpm treated adit water applied at East Boulder Mine LAD Area 6**		
median adit TDS concentration, SMC monitoring data	550	mg/L	28,877	ft^3/d	adit water volume in cubic feet per day
East Boulder Adit flow rate	150	gpm (24 hr)	300	gpm (12 hr)	East Boulder adit flow rate
adit water TDS concentration when LAD in summer (30% hydraulic evaporation)	786	mg/L			no TDS credit given for evaporation
adit water TDS concentration when LAD in winter (30% hydraulic evaporation)	786	mg/L			no TDS credit given for evaporation
Daily Summer LAD Area 6 TDS load (30% hydraulic evaporation)	**495**	lbs/day			
Total Summer LAD TDS Load/ac/yr	**5,824**	lbs/ac/yr	120	days	time LAD applied (length of LAD season)
Total Summer LAD TDS Load/ft^2	**0.1**	lbs/ft2/yr	10.2	ac	area of LAD
Daily Winter LAD Area 6 TDS Load (30% hydraulic evaporation)	**495**	lbs/day			
Total Winter LAD TDS Load/ft^2	**5,824**	lbs/ac/yr			
Total Winter LAD TDS Load/ft^2	**0.1**	lbs/ft2/yr			

Closure Ground Water Salts Calculations for East Boulder Mine LAD Area			**150 gpm treated adit water applied at East Boulder Mine LAD Area 6**
depth of aquifer, **D_2**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, **L_2**	2900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of zone, **W_2**	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, **A_2**	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of Ground Water available for mixing **Q_2**=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
Volume of Ground Water available for mixing **Q_1**=kiA	76,955 ft^3/d		calculation per 17.30.517(d); MPDES Statement of Basis, p. 25-26
concentration of salt in adit waters	550 mg/L		calculated above
adit water TDS concentration when LAD in summer or winter (30% hydraulic evaporation)	786 mg/L		
median concentration of TDS in ground water below percolation pond at EBMW-6, **C_2**	**259** mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
upgradient concentration of TDS in ground water (WW-1)	106 mg/L		median value SMC Monitoring Data 1989-2008
receiving stream baseline ambient concentration at EBR-001	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
Volume of water: summer LAD, **V_s**	40,428 ft^3/d	210 gpm (12 hr)	summer volume disposed at LAD area 6 that reaches ground water (30% evaporation)
Volume of water: winter snowmaking, **V_{W1}**	40,428 ft^3/d	210 gpm (12 hr)	winter volume disposed at LAD area 6 that reaches ground water (30% evaporation)
summer concentration of ground water, Z_s	325 mg/L	**506** µmhos/cm	projected **summer** concentration of TDS and EC in ground water at SP-11 just prior to discharging to East Boulder River
winter concentration of ground water, Z_W	325 mg/L	**506** µmhos/cm	projected **winter** concentration of TDS and EC in ground water at SP-11 just prior to discharging to East Boulder River

The EC in ground water meets the 1,000 µmhos/cm Class I Beneficial Use Criterion during both summer LAD and winter snowmaking.

East Boulder River Salts Concentration below LAD area			**150 gpm treated adit water applied at East Boulder Mine LAD Area 6**
receiving streamflow, **Q_s**	432,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
irrigation season receiving streamflow, **Q_s**	172,800 ft^3/d	2.0 cfs	flow in stream during irrigation season
receiving stream ambient concentration, **C_s**	45 mg/L		median concentration SMC Monitoring Data 2004-2009
ground water discharge volume, **Q_{ds}**	145,273 ft^3/d	1.7 cfs	
ground water discharge volume, **Q_{dw}**	145,273 ft^3/d	1.7 cfs	
summer discharge concentration to East Boulder River, **C_{ds}**	325 mg/L		summer concentration of salt in ground water just prior to discharging to East Boulder River
winter discharge concentration to East Boulder River, **C_{dw}**	325 mg/L		winter concentration of salt in ground water just prior to discharging to East Boulder River
Summer East Boulder River TDS concentration (5.0 cfs 7Q10)	**115 mg/L**	180 µmhos/cm	calculated concentration at 7Q10 low flow
Winter East Boulder River TDS concentration (5.0 cfs 7Q10)	**115 mg/L**	180 µmhos/cm	calculated concentration at 7Q10 low flow

The TDS concentration in the East Boulder River does not exceed the 250 mg/L recommendation protective of trout eggs.

Spreadsheet 2B Nitrogen: Proposed Action Alternative 2B East Boulder Mine Closure Nitrogen Analyses

Per KP 2000c, the preferential manner of disposal of treated adit and tailings waters is at the percolation pond and the mine LAD areas. For the East Boulder Mine, the calculations have been made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine LAD area, any water that percolates below the root zone is assumed to immediately enter the ground water. No unsaturated zone was considered. To determine the concentration of total inorganic nitrogen (TIN) in ground water, it was assumed that all ground water flow parallels the East Boulder River and enters the river at a point at, or just downstream of, the permit boundary (near EBR-004/4A). Tailings impoundment waters would be treated and routed the same as adit water. East Boulder has a source-specific mixing zone at the mine per the MPDES permit for the portion of the aquifer beneath the tailings impoundment. The MPDES permit does not allow evaporation or treatment credit when when disposal is by percolation. The PoleCat evaporators and center pivots accomplish 30% evaporation in summer and winter. The scenarios evaluated below consider the onset of closure in summer (Summer Closure) and in winter (Winter Closure), which are important with respect to the volume of water that may be disposed by land application (LAD or snowmaking LAD). The East Boulder Mine MPDES permit allows a monthly average 30 lbs/day total inorganic nitrogen (TIN) limit on discharge. The water disposal design capacities are from CES 2008. The East Boulder Mine is required to maintain the 30 lbs/day or less average MPDES permit TIN limit, regardless of influent TIN concentrations. It is assumed that the existing treatment systems would be augmented to meet hydraulic load and contaminant requirements. All waters are treated prior to discharge. All treatment forms: evaporation, LAD, and BTS/Anox are totaled to meet the 30 lbs/day discharge limit The values listed below are projected values based on available data and limited spreadsheet modeling capability, and are reasonable estimates of what would be expected to occur during closure.

Proposed Alternative 2B, Option 1, 737 gpm: Up to 737 gpm (24 hr)adit water and 263 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the mine percolation pond. The time frame for closure is 12 months.

For all analyses in this sheet:			**20**	lbs/day	Historical maximum load from BTS/Anox system at East Boulder Mine
BTS/Anox system assumed to treat total inorganic nitrogen at 1,000 gpm rate			**737**	gpm (24 hr)	adit flow rate at closure
Percolation pond can accommodate at least 1,000 gpm rate			**263**	gpm (24 hr)	tailings flow rate at closure; fixed by BTS/Anox system treatment rate 1000 gpm
			2.3	mg/L	treated total inorganic nitrogen conc of adit waters based on historical BTS/Anox treatment and flow rate
influent total inorganic nitrogen concentration of tailings waters	**50**	mg/L	**10**	mg/L	Current BTS/Anox 80% treatment efficiency for tailings water
			4.3	mg/L	weighted average post BTS/Anox concentration of adit water and tailings water

East Boulder Hydraulic Loading Input Parameters, closure					
East Boulder Tailings Impoundment discharge volume	40	MG	106	days	time to dewater the tailings impoundment at given rate
rate to dewater East Boulder tailings impoundment	**263**	gpm (24 hr)	**526**	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**737**	gpm (24 hr)	**1,474**	gpm (12 hr)	adit flow rate
total flow rate to BTS/Anox	**1,000**	gpm (24 hr)	**2,000**	gpm (12 hr)	total flow of combined adit plus East Boulder tailings waters
Days 1-106 total inorganic nitrogen load of treated adit plus tailings waters disposed at the percolation pond	51.6	lbs/day	**2,210**	gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4
Days 107-365 total inorganic nitrogen load of treated adit water disposed at the percolation pond	**20.0**	lbs/day			

Percolation of up to 737 gpm (24 hr) treated adit waters with 263 gpm (24 hr) treated tailings waters would not exceed the hydraulic capacity of the East Boulder Mine percolation pond.

Days 1-106, disposal of 737 gpm treated adit and 263 gpm treated tailings waters using only percolation exceeds the MPDES 30 lbs/day total inorganic nitrogen limit. Additional treatment methods must be employed such as LAD. Days 107-365, the disposal of treated adit water would not exceed the MPDES 30 lbs/day limit.

Proposed Alternative 2B, Option 2, 737 gpm: Maximize LAD treatment of total inorganic nitrogen for adit and tailings waters disposal at the East Boulder Mine LAD areas. Due to the adit flow rate, the agencies assume that all LAD areas (2, 3-Upper, 4, and 6) are constructed and operatotal inorganic nitrogeng. At a flow rate of 737 gpm (24 hr) plus disposal of 40 MG of tailings at 263 gpm (24 hr), the water can only be managed using a combination of percolation and LAD. The time frame for closure is 12 months.

			20	lbs/day	Historical maximum load from BTS/Anox system at East Boulder Mine
			737	gpm (24 hr)	adit flow rate at closure
			263	gpm (24 hr)	tailings flow rate at closure; fixed by BTS/Anox system treatment rate 1000 gpm
			2.3	mg/L	treated total inorganic nitrogen conc of adit waters based on historical BTS/Anox treatment and flow rate
influent total inorganic nitrogen concentration of tailings waters	**50**	mg/L	**10**	mg/L	Current BTS/Anox 80% treatment efficiency for tailings water

East Boulder MPDES Permit Source-Specific (percolation pond) mixing zone calculations			**4.3**	mg/L	weighted average post BTS/Anox concentration of adit water and tailings water
depth of aquifer, **D**	80	ft			MPDES Statement of Basis, p. 25-26;
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to compliance wells EBMW-6 and EBMW-7, L_1	3,600	ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, Q_1	77,005	ft^3/d	400	gpm (24 hr)	MPDES Statement of Basis, p. 25-26
upgradient concentration of total inorganic nitrogen in ground water at WW-1, C_A	0.15	mg/L			MPDES Statement of Basis, p. 24
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, W_1	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_1	55,977	ft^2			D * W, allowed by 17.30.517(d)
East Boulder Hydraulic Load Input Parameters, closure			**Dispose of the maximum amount of treated adit plus tailings waters at the mine LAD areas, then percolate any remaining waters. The volume of mixed treated water disposed at the LAD areas will depend on the timing of onset of Closure**		
East Boulder Tailings Impoundment discharge volume	40	MG	106	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**263**	gpm (24 hr)	**526**	gpm (12 hr)	rate to dewater the impoundment
East Boulder Adit Flow rate	**737**	gpm (24 hr)	**1,474**	gpm (12 hr)	Adit Flow rate
total combined flow rate of adit plus East Boulder tailings waters	**1,000**	gpm (24 hr)	**2,000**	gpm (12 hr)	total combined flow rate of adit plus East Boulder tailings waters
Summer LAD Area 6 maximum hydraulic load	**56,406**	**ft^3/d**	**586**	gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer LAD Area 4 maximum hydraulic load	26,952	ft^3/d	280	gpm (12 hr)	evaporator maximum flow rate, 11.2 ac (CES 2008)
Summer LAD Area 3 Upper maximum hydraulic load	26,952	ft^3/d	280	gpm (12 hr)	evaporator maximum flow rate, 11.3 ac (CES 2008)
Summer LAD Area 2 maximum hydraulic load	29,262	ft^3/d	304	gpm (12 hr)	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer maximum hydraulic load: LAD areas 2, 3, 4, 6	**139,572**	**ft^3/d**	**1,450**	gpm (12 hr)	summer LAD total hydraulic load in gpm
Summer additional volume of water needing disposal, assume percolation	**52,941**	**ft^3/d**	**550**	gpm (12 hr)	assume additional water is percolated
Winter LAD Area 6 snowmaking maximum hydraulic load	**39,465**	**ft^3/d**	**410**	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter LAD Area 4 snowmaking maximum hydraulic load	7,701	ft^3/d	80	gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac (CES 2008)
Winter LAD Area 3 Upper snowmaking maximum hydraulic load	7,701	ft^3/d	80	gpm (12 hr)	snowmaker maximum flow rate 11.3 ac (CES 2008)
Winter maximum snowmaking hydraulic load, LAD areas 3, 4, 6	**54,866**	**ft^3/d**	**570**	gpm (12 hr)	total snowmaking rate on LAD areas 3-upper, 4, and 6 over 32.7 ac
Winter additional volume of water needing disposal	**137,647**	**ft^3/d**	**1,430**	gpm (12 hr)	assume additional water is percolated

The hydraulic load of 737 gpm treated adit waters plus 263 gpm treated East Boulder tailings impoundment waters exceeds the capacity of the East Boulder Mine LAD in both summer and winter; additional water management measures such as percolation must be used. If the East Boulder tailings impoundment is dewatered during summer, up to 275 gpm (24 hr) would be percolated. If the East Boulder tailings impoundment is dewatered during winter, up to 715 gpm (24 hr) would be percolated.

Proposed Alternative 2B, Option 3, 737 gpm: Maximize LAD treatment of total inorganic nitrogen for adit and tailings waters disposal at the East Boulder Mine LAD areas (salts are not treated by LAD) and dispose of excess waters at the mine percolation pond. Due to the adit flow rate, the agencies assume that all LAD areas (2, 3-Upper, 4, and 6) are constructed and operatotal inorganic nitrogeng. At a flow rate of 737 gpm (24 hr) plus disposal of 40 MG of tailings at 263 gpm (24 hr), the water can only be managed using a combination of percolation and LAD. The time frame for closure is 12 months.

Closure Summer LAD total inorganic nitrogen load East Boulder Mine, LAD areas 2, 3-Upper, 4, 6 average daily load for LAD season	**7.5** lbs/day	4.3 mg/L	weighted average post BTS/Anox concentration of adit water and tailings water days 1-106
LAD Area 6 flow rate (30% hydraulic evaporation, 80% nitrogen credit post plant uptake)	39,484 ft^3/d	**3.0** lbs/day	evaporator maximum flow rate, weighted average load for 120 day summer LAD season
LAD Area 4 flow rate (30% hydraulic evaporation, 80% nitrogen credit post plant uptake)	18,866 ft^3/d	**1.4** lbs/day	evaporator maximum flow rate, weighted average load for 120 day summer LAD season
LAD Area 3 Upper flow rate (30% hydraulic evaporation, 80% nitrogen credit post plant uptake)	18,866 ft^3/d	**1.4** lbs/day	evaporator maximum flow rate, weighted average load for 120 day summer LAD season
LAD Area 2 flow rate center pivot (30% hydraulic evaporation, 80% nitrogen credit post plant uptake)	20,483 ft^3/d	**1.6** lbs/day	center pivot maximum flow rate, weighted average load for 120 day summer LAD season
summer: additional volume of water needing percolation during LAD	550 gpm (24 hr)	105,882 ft^3/d	**summer:** additional volume of water needing percolation
average daily total inorganic nitrogen percolation load during summer LAD season	**13.4** lbs/day	**Summer closure total inorganic nitrogen load from percolation and LAD at areas 2, 3-Upper, 4, and 6; agencies assumed that LAD occurs 120 days; closure lasts 12 months**	
Summer LAD plus percolation load during LAD season	**20.9** lbs/day		
CLOSURE total total inorganic nitrogen Load through LAD to ground water	**897** lbs/yr	**2,369** lbs/yr	**Summer CLOSURE total total inorganic nitrogen load applied to soil from LAD**
Summer CLOSURE total inorganic nitrogen Load to percolation (excess waters)	**6,889** lbs/yr	365 days	Days 1-106 excess treated adit plus tailings waters; days 107-120 excess treated adit water; days 121-365 all treated adit waters percolated
total inorganic nitrogen load per acre for Summer LAD season	**51** lbs/ac	46.6 ac	total area of East Boulder Mine LAD areas 2, 3-Upper, 4 and 6
total inorganic nitrogen load per square foot for Summer CLOSURE	**0.1** $lbs/ft^2/y$	2.3 mg/L	Days 1-106 excess treated adit plus tailings waters; days 107-120 excess treated adit water; days 121-365 all treated adit waters percolated
Total Summer Closure total inorganic nitrogen Load (LAD plus percolation)	**7,786** lbs/yr	120 days	agency-assumed length of the LAD season
Closure Winter Snowmaking LAD total inorganic nitrogen load East Boulder Mine, LAD areas 3-Upper, 4, 6; average daily load for LAD season	**2.9** lbs/day	4.3 mg/L	weighted average post BTS/Anox total inorganic nitrogen concentration of mixed adit plus tailings water days 1-106
LAD Area 6 snowmaking rate (30% hydraulic evaporation, 80% nitrogen post snowmaking credit)	39,465 ft^3/d	**2.1** lbs/day	snowmaker maximum flow rate, 10.2 ac (CES 2008)
LAD Area 4 snowmaking rate (30% hydraulic evaporation, 80% nitrogen post snowmaking credit)	7,701 ft^3/d	**0.4** lbs/day	snowmaker maximum flow rate, 11.2 ac (CES 2008)
LAD Area 3-Upper snowmaking rate (30% hydraulic evaporation, 80% nitrogen post snowmaking credit)	7,701 ft^3/d	**0.4** lbs/day	snowmaker maximum flow rate 11.3 ac (CES 2008)
winter: additional volume of water needing percolation during snowmaking LAD	1,430 gpm (12 hr)	137,647 ft^3/d	additional volume of water needing percolation during a winter closure
average daily total inorganic nitrogen percolation load during winter snowmaking season	**34.8** lbs/day		
Winter snowmaking plus percolation load during LAD season	**37.7** lbs/day	**Winter closure total inorganic nitrogen load from percolation and LAD at areas 3-Upper, 4, and 6; agencies assumed that snowmaking LAD occurs 120 days; closure lasts 12 months**	
CLOSURE total total inorganic nitrogen Load through snowmaking LAD to ground water	**353** lbs/yr	**931** lbs/yr	**Winter CLOSURE total total inorganic nitrogen load applied to soil from snowmaking**

Winter CLOSURE total inorganic nitrogen load to percolation (excess waters)	**9,073** lbs/yr			Days 1-106 excess treated adit plus tailings waters; days 107-120 excess treated adit water; days 121-365 all treated adit waters percolated
total inorganic nitrogen load per acre for Winter snowmaking LAD season	**28** lbs/ac/yr	32.7 ac		total area of East Boulder Mine LAD areas 3-Upper, 4 and 6
total inorganic nitrogen load per square foot for Winter CLOSURE	**0.0** lbs/ft^2/y	120 days		agency-assumed length of the snowmaking LAD season
Total Winter Closure total inorganic nitrogen Load (Snowmaking LAD plus percolation)	**9,425** lbs/yr			

The total inorganic nitrogen load produced from 737 gpm treated adit water and 263 gpm treated tailings waters during a summer closure scenario would be less than the MPDES permit 30 lbs/day total inorganic nitrogen limit at the mine. The total inorganic nitrogen load produced from 737 gpm treated adit water and 263 gpm treated tailings waters during a winter closure scenario would be greater than the MPDES permit 30 lbs/day total inorganic nitrogen limit at the mine.

Ground Water Inputs Below East Boulder Mine LAD area, at Closure		**Disposal of up to 737 gpm (24 hr) treated adit water plus 263 gpm (24 hr) treated tailings waters at the maximum rates, with percolation of the excess treated mixed water.**	
depth of aquifer, $\mathbf{D_2}$	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d);
median concentration of total inorganic nitrogen in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	1.2 mg/L		assumed median value of total inorganic nitrogen at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
concentration of total inorganic nitrogen in mixed waters needing disposal	4.3 mg/L		treated total inorganic nitrogen conc of adit waters based on MPDES 30 lbs/day limit, flow rate
upgradient concentration of total inorganic nitrogen in ground water at WW-1, $\mathbf{C_A}$	0.2 mg/L		MPDES Statement of Basis, p. 24
assumed East Boulder tailings impoundment leak, $\mathbf{V_{TI}}$	193 ft^3/d	1 gpm (24 hr)	equivalent to the assumed leak at the Hertzler Ranch LAD for the Hertzler Ranch tailings impoundment
total inorganic nitrogen concentration of tailings impoundment water, $\mathbf{C_{TI}}$	4 mg/L		SMC Hertzler underdrain total inorganic nitrogen concentration, SMC monitoring data
Volume of water: summer LAD, $\mathbf{V_s}$	97,701 ft^3/d	508 gpm (24 hr)	summer volume from LAD areas 2, 3-Upper, 4, 6
Volume of water percolated in summer, $\mathbf{V_{Sp}}$	52,941 ft^3/d	275 gpm (24 hr)	
Volume of water: winter snowmaking, $\mathbf{V_{Ws}}$	38,406 ft^3/d	200 gpm (24 hr)	winter volume from LAD areas 3, 4, 6; adit plus tailings waters to capacity (evaporation credit taken)
Volume of water percolated in winter, $\mathbf{V_{Wp}}$	275,294 ft^3/d	1,430 gpm (24 hr)	winter volume from percolation; additional water
projected summer total inorganic nitrogen concentration of ground water, $\mathbf{Z_s}$	**2.0 mg/L**		projected **summer** concentration of total inorganic nitrogen in ground water just prior to discharging to East Boulder River (at SP-11) days 1-120
projected winter total inorganic nitrogen concentration of ground water, $\mathbf{Z_W}$	**2.4 mg/L**		projected **winter** concentration of total inorganic nitrogen in ground water just prior to discharging to East Boulder River (at SP-11) days 1-120

The projected total inorganic nitrogen concentrations in ground water from the disposal of 737 gpm (24 hr) treated adit water and 263 gpm (24 hr) treated tailings waters in both summer and winter would be less than 10 mg/L.

East Boulder River Concentration below LAD area at Closure			**Disposal of up to 737 gpm (24 hr) treated adit water plus 263 gpm (24 hr) treated tailings waters at the maximum rates, with percolation of the excess treated mixed water.**			
receiving streamflow, $\mathbf{Q_s}$	432,000	ft^3/d	5.0	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4	
receiving stream ambient concentration, $\mathbf{C_s}$	0.2	mg/L			MPDES Statement of Basis, p. 24	
discharge volume through ground water, $\mathbf{Q_{ds}}$	308,671	ft^3/d	3.6	cfs	summer discharge volume through ground water in cubic feet per second	
discharge volume through ground water, $\mathbf{Q_{dw}}$	281,142	ft^3/d	3.3	cfs	winter discharge volume through ground water in cubic feet per second	
projected summer discharge concentration to East Boulder River, $\mathbf{C_{ds}}$	2.0	mg/L			based on summer concentration of ground water near SP-11, days 1-120	
projected winter discharge concentration to East Boulder River, $\mathbf{C_{dw}}$	2.4	mg/L			based on winter concentration of ground water near SP-11, days 1-120	
East Boulder River projected total inorganic nitrogen concentration in Summer, days 1-120	**0.9**	**mg/L**			projected total inorganic nitrogen concentration in the East Boulder River at EBR-004/004A for the summer closure scenario, days 1-120	
East Boulder River projected total inorganic nitrogen concentration in Winter, days 1-120	**1.0**	**mg/L**			projected total inorganic nitrogen concentration in the East Boulder River at EBR-004/004A in winter closure scenario, days 1-120	

The projected total inorganic nitrogen concentration produced in the East Boulder River during this summer closure scenario would meet the MPDES 1 mg/L total inorganic nitrogen limit. The projected total inorganic nitrogen concentration produced in the East Boulder River during this winter closure scenario would be at the 1 mg/L total inorganic nitrogen limit in the East Boulder River, and SMC may have to adjust the length or timing of closure.

Proposed Alternative 2B, Option 1, 150 gpm: Up to 150 gpm (24 hr) treated adit water flow and 232 gpm (24 hr) treated tailings water would be percolated at the East Boulder Mine. The time frame for closure would be 12 months.

			20	lbs/day	Historical maximum load from BTS/Anox system at East Boulder Mine
			150	gpm (24 hr)	adit flow rate at closure
			232	gpm (24 hr)	tailings flow rate at closure; fixed by BTS/Anox system treatment rate 1000 gpm
			11.1	mg/L	treated total inorganic nitrogen conc of adit waters based on historical BTS/Anox treatment and flow rate
influent total inorganic nitrogen concentration of tailings waters	**50**	mg/L	**10**	mg/L	Current BTS/Anox 80% treatment efficiency for tailings water
			10.4	mg/L	weighted average post BTS/anox concentration of adit water and tailings water
East Boulder Hydraulic Loading Input Parameters, closure					
East Boulder Tailings Impoundment discharge volume	40	MG	120	days	time to dewater the tailings impoundment at given rate
rate to dewater East Boulder tailings impoundment	**232**	gpm (24 hr)	**464**	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150**	gpm (24 hr)	**300**	gpm (12 hr)	adit flow rate
total flow rate to BTS/Anox	**382**	gpm (24 hr)	**764**	gpm (12 hr)	total flow of combined adit plus East Boulder tailings waters
Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at the percolation pond	**47.8**	lbs/day	**2,210**	gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

Percolation of up to 150 gpm (24 hr) treated adit waters with 232 gpm (24 hr) treated tailings waters would not exceed the hydraulic capacity of the East Boulder Mine percolation pond.

Disposal of up to 150 gpm (24 hr) treated adit and 232 gpm (24 hr) tailings waters using only percolation would exceed the MPDES 30 lbs/day total inorganic nitrogen limit days 1-120. Additional total inorganic nitrogen treatment methods would need to be employed such as LAD.

Appendix C
DEQ 2010

Proposed Alternative 2B, Option 2, 150 gpm: The 150 gpm (24 hr) adit water plus 232 gpm (24 hr) tailings waters would be treated and routed for disposal at the East Boulder Mine LAD Area 6 (LAD Areas 2, 3-Upper, and 4 would not be built.) The time frame for closure would be 12 months.

East Boulder Hydraulic and total inorganic nitrogen Loading Input Parameters, closure					**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD Area 6 rates.**
East Boulder Tailings Impoundment discharge volume	40	MG	120	days	time to dewater the tailings impoundment at given rate
rate to dewater East Boulder tailings impoundment	**232**	gpm (24 hr)	**464**	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150**	gpm (24 hr)	**300**	gpm (12 hr)	adit flow rate
total flow rate to BTS/Anox	**382**	gpm (24 hr)	**764**	gpm (12 hr)	total flow of combined adit plus East Boulder tailings waters
Summer LAD Area 6 maximum hydraulic load	**56,406**	**ft^3/d**	**586**	gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer additional volume of water needing disposal, assume percolation	**17,134**	**ft^3/d**	**178**	gpm (12 hr)	**additional water that must be percolated**
Summer Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at LAD Area 6	**10.5**	lbs/day	**2,210**	gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4
Summer Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters that must be disposed at the percolation pond	**11.1**	lbs/day	**21.6**	lbs/day	**Summer Closure Days 1-120 total total inorganic nitrogen load (LAD Area 6 plus percola**
Summer Closure Days 121-365 total inorganic nitrogen load of treated adit water disposed at the percolation pond	**20.0**	lbs/day	**7,490**	lbs	**TOTAL total inorganic nitrogen load for closure that commences in Summer**
Winter LAD Area 6 snowmaking maximum hydraulic load	**39,465**	**ft^3/d**	**410**	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter additional volume of water needing disposal	**34,075**	**ft^3/d**	**354**	gpm (12 hr)	**additional water that must be percolated**
Winter Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at LAD Area 6	**7.3**	lbs/day			
Winter Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters that must be disposed at the percolation pond	**22.2**	lbs/day	**29.5**	lbs/day	**Winter Closure Days 1-120 total total inorganic nitrogen load (LAD Area 6 plus percolati**
Days 121-365: total inorganic nitrogen load of percolation disposal of 150 gpm (24 hr) treated adit water	**20.0**	lbs/day	**8,432**	lbs	**TOTAL total inorganic nitrogen load for closure that commences in Winter**

Land application of up to 150 gpm (24 hr) treated adit waters with 232 gpm (24 hr) treated tailings waters would exceed the hydraulic capacity of the East Boulder Mine LAD Area 6. The percolation pond must be used to dispose of excess water during closure.

Proposed Alternative 2B, Option 3, 150 gpm: Maximize LAD treatment of total inorganic nitrogen for adit and tailings waters disposal at the East Boulder Mine LAD Area 6 (LAD Areas 2, 3-Upper, and 4 would not be built.) Dispose of excess waters at the East Boulder Mine percolation pond. The time frame for closure would be 12 months.

Disposal of up to 150 gpm (24 hr) treated adit and 232 gpm (24 hr) tailings waters using summer LAD and winter snowmaking with percolation of the excess capacity water would not exceed the MPDES permit 30 lbs/day total inorganic nitrogen limit.

East Boulder MPDES Permit Source-Specific percolation pond mixing zone calculations			**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD Area 6 rates, with percolation of the excess treated mixed water.**		
depth of aquifer, **D**	80	ft			MPDES Statement of Basis, p. 25-26;
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3,600	ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400	gpm (24 hr)	77,005	ft^3/d	MPDES Statement of Basis, p. 25-26
upgradient concentration of total inorganic nitrogen in ground water at WW-1, $\mathbf{C_A}$	0.2	mg/L			MPDES Statement of Basis, p. 24
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2			D * W, allowed by 17.30.517(d)
Ground Water Inputs Below East Boulder Mine LAD area, at Closure					
depth of aquifer, $\mathbf{D_2}$	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	700	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
concentration of total inorganic nitrogen in mixed waters	10.4	mg/L	3.0	mg/L	$\mathbf{C_{LAD}}$ concentration of total inorganic nitrogen in mixed waters post plant uptake or snowmaking credit taken
median concentration of total inorganic nitrogen in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	1.2	mg/L			assumed median value of total inorganic nitrogen at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
assumed East Boulder tailings impoundment leak, $\mathbf{V_{TI}}$	193	ft^3/d	1	gpm (24 hr)	equivalent to the assumed leak at the Hertzler Ranch LAD for the Hertzler Ranch tailings impoundment

total inorganic nitrogen concentration of tailings impoundment water, C_{TI}	4 mg/L		SMC Hertzler underdrain total inorganic nitrogen concentration, SMC monitoring data
Volume of water: summer LAD, V_s	39,484 ft^3/d	410 gpm (12 hr)	summer volume from LAD Area 6; 30% evaporation credit taken
Volume of water percolated in summer, V_{W1}	17,134 ft^3/d	178 gpm (12 hr)	Excess water sent to percolation pond in summer
Volume of water: winter snowmaking, V_{W1}	27,626 ft^3/d	287 gpm (12 hr)	winter volume from LAD Area 6; 30% evaporation credit taken
Volume of water percolated in winter, V_{W2}	34,075 ft^3/d	354 gpm (12 hr)	winter volume from percolation; additional water
Volume of water percolated after LAD or snowmaking season days 121-365, V_P	28,877 ft^3/d	150 gpm (24 hr)	volume of water resulting in load to ground water the rest of the year
East Boulder Mine ground water total inorganic nitrogen concentration at Closure		**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD rates, with percolation of the excess treated mixed water.**	
summer concentration of ground water near SP-11, Z_s	**2.1 mg/L**		projected summer concentration of total inorganic nitrogen in ground water just prior to disharging to East Boulder River near SP-11
winter concentration of ground water nar SP-11, Z_W	**2.9 mg/L**		projected winter concentration of total inorganic nitrogen in ground water just prior to disharging to East Boulder River near SP-11

Summer Closure: LAD of 585 gpm (12 hr) treated, mixed adit and tailings waters and percolation of 178 gpm (12 hr) treated, mixed adit and tailings waters at the East Boulder mine would produce concentrations of total inorganic nitrogen in ground water less than the DEQ-7 Nitrogen criterion of 10 mg/L. Winter Closure: Snowmaking LAD of 410 gpm (12 hr) treated, mixed adit and tailings waters and percolation of 354 gpm (12 hr) treated, mixed adit and tailings waters at the East Boulder mine would produce concentrations of total inorganic nitrogen in ground water less than the DEQ-7 Nitrogen criterion of 10 mg/L.

East Boulder River Concentration below LAD area at Closure		**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD rates, with percolation of the excess treated mixed water.**	
receiving streamflow, Q_s	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, C_s	0.2 mg/L		MPDES Statement of Basis page 24
discharge volume through ground water, Q_{ds}	161,707 ft^3/d	1.9 cfs	credit for LAD evaporative losses taken in volume calculations
ground water discharge volume, Q_{dw}	166,596 ft^3/d	1.9 cfs	credit for snowmaking evaporative losses taken in volume calculations
summer discharge concentration to East Boulder River, C_{ds}	2.1 mg/L		projected summer total inorganic nitrogen concentration of ground water near SP-11
winter discharge concentration to East Boulder River, C_{dw}	2.9 mg/L		projected winter total inorganic nitrogen concentration of ground water near SP-11
East Boulder River concentration in Summer	**0.7 mg/L**		projected total inorganic nitrogen concentration in the East Boulder River for Summer Closure
East Boulder River concentration in Winter	**0.9 mg/L**		projected total inorganic nitrogen concentration in the East Boulder River for Winter Closure

These summer and winter closure scenarios project that the concentration of total inorganic nitrogen in the East Boulder River will not exceed the MPDES permit limit of 1 mg/L.

CLOSURE Alternative 2B Option 3, 150 gpm total inorganic nitrogen load		120	days	length of LAD season
Summer Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at LAD Area 6	**7.3** lbs/day	245	days	remainder of 12 closure period after LAD season
Summer Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at the percolation pond	**11.1** lbs/day	**7,118**	lbs/yr	**Summer Closure Days 1-365 total total inorganic nitrogen load to ground water**
Summer Closure Days 121-365 total inorganic nitrogen load of treated adit water disposed at the percolation pond	**20.0** lbs/day	**18.5**	lbs/day	Summer Closure Days 1-120 total total inorganic nitrogen load (LAD Area 6 plus percolation)
Winter Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at LAD Area 6	**5.1** lbs/day			
Winter Closure Days 1-120 total inorganic nitrogen load of treated adit plus tailings waters disposed at the percolation pond	**22.2** lbs/day	**8,176**	lbs/yr	**Winter Closure Days 1-365 total total inorganic nitrogen load to ground water**
Days 121-365: total inorganic nitrogen load of percolation disposal of 150 gpm (24 hr) treated adit water	**20.0** lbs/day	**27.3**	lbs/day	Winter Closure Days 1-120 total total inorganic nitrogen load (LAD Area 6 plus percolation)

Spreadsheet 2B Salts: Proposed Action Alternative 2B East Boulder Mine Closure Salinity Analyses

Per KP 2000c, the preferential manner of disposal of treated adit and tailings waters is at the percolation pond and the mine site LAD areas. For the East Boulder Mine, the calculations have been made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine LAD area, any water that percolates below the root zone is assumed to immediately enter the ground water. The aquifer beneath the East Boulder mine has been designated as Class I Beneficial Use, and has an electrical conductivity (EC) less than 1,000 µmhos/cm. The MPDES permit does not set a limit for TDS or EC in surface water. The so the calculations assume that salts are concentrated by evaporation. The calculations do not allow evaporation credit for percolation. The BTS/Anox system does not treat salts. The salts load is calculated from the TDS concentration. These calculations allow LAD evaporation credit for water volume only. No treatment occurs by evaporation for salts. The tailings impoundment waters would be mixed and routed with the adit water. For hydraulic volume calculations, the PoleCat evaporators and center pivots both accomplish 30% evaporation in summer. PoleCat snowmakers accomplish 30% evaporation in winter. The water disposal design capacities cited below are from KP 2000c and CES 2008. The concentrations of TDS or measured EC at spring SP-11 (downgradient of East Boulder Mine percolation and LAD areas) are assumed to be representative of the aquifer affected by applied mine waters. The agencies assumed a 1 gpm (24 hr) leak in the tailings impoundment, as in the Stillwater Mine Alternatives. To evaluate effects, the agencies are using a fisheries and aquatic life recommendation that the TDS concentration in surface water not exceed 250 mg/L to protect fertilization of trout eggs.

Proposed Alternative 2B, Option 1, 737 gpm: Up to 737 gpm (24 hr) adit water and 263 gpm (24 hr) East Boulder tailings would be treated in the BTS/Anox system for nitrogen then preferentially disposed at the mine percolation pond. The time frame for closure is 12 months.

			550 mg/L	median **adit** TDS concentration derrived from SMC monitoring data
			854 mg/L	median **tailings waters** TDS concentration derived from SMC monitoring data
			737 gpm (24 hr)	adit flow rate at closure
			263 gpm (24 hr)	tailings water flow rate at closure
East Boulder MPDES Source-Specific (percolation pond) mixing zone input parameters			630 mg/L	weighted average TDS concentration of **adit plus tailings waters** at closure
depth of aquifer, **D**	80 ft			MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385 ft			MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600 ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3			MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400 gpm (24 hr)		77,005 ft^3/d	MPDES Statement of Basis, p. 25-26
upgradient/background concentration of TDS in ground water at WW-1, $\mathbf{C_A}$	106 mg/L		165 µmhos/cm	SMC Monitoring Data
angle of dispersion	0.087421693 tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977 ft^2			D * W, allowed by 17.30.517(d)
East Boulder Hydraulic Loading Input Parameters, closure			106 days	time to dewater the tailings impoundment
East Boulder Tailings impoundment discharge volume	40 MG		**526** gpm (12 hr)	rate to dewater the impoundment
24 hr rate to dewater East Boulder tailings impoundment	**263** gpm (24 hr)		141,882 ft^3/d	volume of adit water in cubic feet per day
volume of water from East Boulder Tailings impoundment in cubic feet per day	50,631 ft^3/d		**1,474** gpm (12 hr)	adit flow rate
East Boulder Adit Flow rate	**737** gpm (24 hr)		**2,000** gpm (12 hr)	total flow rate to BTS/Anox
total flow rate to BTS/Anox	**1,000** gpm (24 hr)		**2,210** gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

Percolation of up to 737 gpm (24 hr) treated adit waters with 263 gpm (24 hr) treated tailings waters would not exceed the hydraulic capacity of the East Boulder Mine percolation pond.

Summer or Winter Salts load of treated, mixed adit plus tailings waters disposed at the percolation pond (days 1-106)	**7,559** lbs/day			**Up to 737 gpm (24 hr) adit water and 263 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the mine site percolation pond.**
Summer or Winter Salts load of treated, mixed adit water disposed at the percolation pond (days 107-365)	**4,864** lbs/day	**2,060,100**	lbs/yr	**Total salts load during 365 days of closure**
Ground Water Mixing Inputs Below East Boulder Mine LAD area, at Closure				**Up to 737 gpm (24 hr) adit water and 263 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the mine site percolation pond.**
depth of aquifer, $\mathbf{D_2}$	15 ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft			MPDES Statement of Basis, p. 25-26

width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
weighted concentration of salt in mixed adit plus tailings waters	**630** mg/L		calculated above
median concentration of TDS in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	**259** mg/L	404 μmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
receiving stream baseline ambient concentration at EBR-001, $\mathbf{C_S}$	**49** mg/L	76 μmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
assumed East Boulder tailings impoundment leak, $\mathbf{V_{TI}}$	193 ft^3/d	1 gpm (24 hr)	equivalent to the assumed leak at the Hertzler Ranch LAD for the Hertzler Ranch tailings impoundment
TDS concentration of tailings impoundment water, $\mathbf{C_{TI}}$	**854** mg/L	1,332 μmhos/cm	tailings waters EC calculated from TDS that was derived from SMC monitoring data
Volume of water: summer or winter adit plus tailings waters percolated, $\mathbf{V_p}$	192,513 ft^3/d	1,000 gpm (24 hr)	Volume of water to be percolated
days 1-106 concentration of salt in ground water at $\mathbf{Z_p}$	480 mg/L	**750** μmhos/cm	projected concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) for days 1-106
days 107-365 concentration of salt in ground water at $\mathbf{Z_p}$	404 mg/L	**630** μmhos/cm	projected concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) for days 107-365

Percolation of up to 737 gpm (24 hr) treated adit water with 263 gpm (24 hr) treated tailings waters is projected to produce an Electrical Conductivity (EC) in ground water less than the 1,000 μmhos/cm Class I Beneficial use criterion during closure.

East Boulder River Concentration near EBR-004/4A		**Days 1-106, up to 737 gpm (24 hr) adit water and 263 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the mine percolation pond. Days 107-365, up to 737 gpm (24 hr) treated adit water would be disposed at the mine percolation pond.**	
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	49 mg/L	76 μmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
days 1-106 discharge volume of ground water, $\mathbf{Q_d}$	297,409 ft^3/d		hydraulic evaporative losses taken in volume calculations
days 107-365 discharge volume of ground water, $\mathbf{Q_d}$	246,971 ft^3/d		
Days 1-106 ground water discharge TDS concentration to East Boulder River, $\mathbf{C_d}$	480 mg/L	750 μmhos/cm	concentration of salt in ground water just prior to discharging to the East Boulder River days 1-106
Days 107-365 ground water discharge TDS concentration to East Boulder River, $\mathbf{C_d}$	404 mg/L	630 μmhos/cm	concentration of salt in ground water just prior to discharging to the East Boulder River days 107-365
East Boulder River TDS concentration below East Boulder Mine days 1-106	**225 mg/L**	351 μmhos/cm	projected salt concentration of East Boulder River after percolation of mixed, treated East Boulder adit and tailings waters days 1-106
East Boulder River TDS concentration below East Boulder Mine days 107-365	**178 mg/L**	278 μmhos/cm	projected salt concentration of East Boulder River after percolation of treated East Boulder adit water days 107-365

The TDS concentration in the East Boulder River from the percolation of 737 gpm (24 hr) treated adit water plus 263 gpm (24 hr) treated tailings water is projected to be less than the 250 mg/L recommendation for the protection of trout eggs.

Proposed Alternative 2B, Option 2, 737 gpm: Maximize LAD treatment of total inorganic nitrogen for adit and tailings waters disposal at the East Boulder Mine LAD areas (salts are not treated by LAD). Due to the adit flow rate, the agencies assume that all LAD areas (2, 3-Upper, 4, and 6) are constructed and operating. Adit water at 737 gpm (24 hr) is disposed with 40 MG of tailings at 263 gpm (24 hr). The time frame for closure is 12 months.

EC of adit waters based on median TDS concentration	858 μmhos/cm	**550** mg/L	median adit TDS concentration derived from SMC monitoring data
EC of tailings waters based on median TDS concentration	1,332 μmhos/cm	**854** mg/L	median tailings waters TDS concentration derived from SMC monitoring data
weighted average EC of mixed treated adit plus tailings waters	983 μmhos/cm	**737** gpm (24 hr)	**adit** flow rate at closure
		263 gpm (24 hr)	**tailings waters** pumping rate at closure
East Boulder MPDES Permit Source-Specific (percolation pond) mixing zone calculations		**630** mg/L	weighted average concentration of TDS in mixed treated adit plus tailings waters
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26

ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400 gpm (24 hr)		MPDES Statement of Basis, p. 25-26
upgradient/background concentration of TDS in ground water at WW-1, $\mathbf{C_A}$	106 mg/L	165 μmhos/cm	SMC Monitoring Data
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977 ft^2		D * W, allowed by 17.30.517(d)
East Boulder Hydraulic Loading Input Parameters, closure		**Summer Closure: LAD 1,450 gpm (12 hr) treated adit plus tailings waters and percolate 550 gpm (12 hr) treated adit plus tailings waters. Winter Closure: Snowmaking LAD 570 gpm (12 hr) treated adit plus tailings waters and percolate 1,430 gpm (12 hr) treated adit plus tailings waters.**	
East Boulder Tailings impoundment discharge volume	40 MG	106 days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**263** gpm (24 hr)	**526** gpm (12 hr)	rate to dewater the impoundment in 106 days
volume of water from East Boulder Tailings impoundment per day	50,631 ft^3/d	141,882 ft^3/d	volume of adit water in cubic feet per day
East Boulder Adit Flow rate	**737** gpm (24 hr)	**1,474** gpm (12 hr)	Adit Flow rate
total combined flow (adit plus East Boulder tailings waters)	**1,000** gpm (24 hr)	**2,000** gpm (12 hr)	total combined flow (adit + East Boulder tailings waters)
Summer LAD Area 6 maximum hydraulic load	**56,406 ft^3/d**	**586** gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer LAD Area 4 maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.2 ac (CES 2008)
Summer LAD Area 3 Upper maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.3 ac (CES 2008)
Summer LAD Area 2 maximum hydraulic load	29,262 ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer maximum hydraulic load , LAD areas 2, 3, 4, 6	**139,572 ft^3/d**	**1,450** gpm (12 hr)	
Summer additional volume of water needing disposal (12 hr)	**52,941 ft^3/d**	**550** gpm (12 hr)	assume percolation is used to dispose of excess water
Winter LAD Area 6 snowmaking maximum hydraulic load	**39,465 ft^3/d**	**410** gpm (12 hr)	snowmaker maximum flow rate (CES 2008)
Winter LAD Area 4 snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate (CES 2008)
Winter LAD Area 3 Upper snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate (CES 2008)
Winter maximum snowmaking hydraulic load, LAD areas 3, 4, 6	**54,866 ft^3/d**	**570** gpm (12 hr)	
Winter additional volume of water needing disposal (12 hr)	**137,647 ft^3/d**	**1,430** gpm (12 hr)	assume percolation is used to dispose of excess water

The hydraulic load of 737 gpm adit waters plus 263 gpm East Boulder tailings impoundment waters exceeds the capacity of the East Boulder Mine LAD in both summer and winter; additional water handling measures such as percolation must be used. If the East Boulder tailings impoundment is dewatered during summer, up to 275 gpm (24 hr) would be percolated. If the East Boulder tailings impoundment is dewatered during winter, up to 715 gpm (24 hr) would be percolated.

Proposed Alternative 2B, Option 3, 737 gpm: Maximize LAD treatment of total inorganic nitrogen for adit and tailings waters disposal at the East Boulder Mine LAD areas (salts are not treated by LAD) and dispose of excess waters at the mine percolation pond. Due to the adit flow rate, the agencies assume that all LAD areas (2, 3-Upper, 4, and 6) are constructed and operating. At a flow rate of 737 gpm (24 hr) plus disposal of 40 MG of tailings at 263 gpm (24 hr), the water can only be managed using a combination of percolation and LAD. The time frame for closure is 12 months.

Closure Summer LAD Salt load East Boulder Mine, LAD areas 2, 3, 4, 6	**5,397** lbs/day	**630** mg/L	concentration of salt in mixed adit plus tailings waters
LAD Area 6 flow rate (30% hydraulic evaporation)	56,406 ft^3/d	2,181 lbs/day	evaporator maximum flow rate, 10.2 ac (CES 2008)
LAD Area 4 flow rate (30% hydraulic evaporation)	26,952 ft^3/d	1,042 lbs/day	evaporator maximum flow rate, 11.2 ac (CES 2008)
LAD Area 3 Upper flow rate (30% hydraulic evaporation)	26,952 ft^3/d	1,042 lbs/day	evaporator maximum flow rate, 11.3 ac (CES 2008)
LAD Area 2 flow rate center pivot (30% hydraulic evaporation)	29,262 ft^3/d	1,132 lbs/day	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer salts LAD total load	**647,667** lbs/yr	46.6 ac	area of applied LAD; summer LAD season
Summer closure salts load to ground water from percolation	**1,481,246** lbs/yr		salts loading to ground water from percolation for 12 month closure commencing in summer
Summer LAD salts load per acre per year	**13,898** lbs/ac/y		per acre salts load applied from LAD; salts concentration occurs during evaporation
Summer LAD salts load per square foot per year	**0.3** lbs/ft2/y	120 days	length of time for LAD season, both summer and winter
Summer Closure Total Salts Load (LAD plus percolation)	**2,128,913** lbs/yr		total salts load applied to soil and ground water at closure
		365 days	closure time frame

Closure Winter Snowmaking LAD Salts load East Boulder Mine, LAD areas 3, 4, 6	**2,122** lbs/day	900 mg/L	effective weighted average concentration of salts in applied water with 30% evaporation; no salts treatment credit
LAD Area 6 snowmaking rate (30% hydraulic evaporation)	39,465 ft^3/d	1,526 lbs/day	snowmaker maximum flow rate (CES 2008)
LAD Area 4 snowmaking rate (30% hydraulic evaporation)	7,701 ft^3/d	298 lbs/day	snowmaker maximum flow rate (CES 2008)
LAD Area 3 snowmaking rate (30% hydraulic evaporation)	7,701 ft^3/d	298 lbs/day	snowmaker maximum flow rate (CES 2008)
additional volume of water needing percolation	1,430 gpm (12 hr)	715 gpm (24 hr)	additional volume of water needing percolation
Winter snowmaking LAD salts total load	**254,600** lbs/yr		salts loading to ground water from percolation for 12 month closure commencing in winter
Winter closure salts load to ground water from percolation	**1,832,550** lbs/yr	32.7 ac	area of applied LAD; winter
Winter snowmaking LAD salts load per acre	**7,786** lbs/ac/yr		per acre salts load applied from Snowmaking during LAD season
Winter snowmaking LAD salts load per square foot per year	**0.2** lbs/ft2/y	120 days	length of time for LAD season, both summer and winter
Total Winter Salts Load (Snowmaking LAD plus percolation)	**2,087,150** lbs/yr		total salts load applied to soil and ground water at closure
Ground Water Mixing Inputs Below East Boulder Mine LAD area, at Closure		**Summer Closure: LAD 1,450 gpm (12 hr) treated adit plus tailings waters and percolate 550 gpm (12 hr) treated adit plus tailings waters. Winter Closure: Snowmaking LAD 570 gpm (12 hr) treated adit plus tailings waters and percolate 1,430 gpm (12 hr) treated adit plus tailings waters.**	
depth of aquifer, $\mathbf{D_2}$	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2		D * W, allowed by 17.30.517(d)
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400 gpm (24 hr)	106 mg/L	MPDES Statement of Basis, p. 25-26; background concentration of TDS in ground water at WW-1
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
concentration of salt in mixed adit plus tailings waters	630 mg/L	550 mg/L	median adit TDS concentration derived from SMC monitoring data
effective concentration of salt applied during Summer and Winter LAD (hydraulic evaporation; no salts treatment credit)	**900** mg/L		30% evaporation credit for both LAD and snowmaking LAD areas 2, 3-Upper, 4, 6
median concentration of TDS in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	**259** mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
receiving stream baseline ambient concentration at EBR-001, $\mathbf{C_A}$	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
Volume of water: summer LAD (hydraulic evaporation included), $\mathbf{V_s}$	195,401 ft^3/d	725 gpm (24 hr)	Volume of water disposed in summer at LAD areas 2, 3, 4, 6
Volume of water: summer percolation, $\mathbf{V_p}$	52,941 ft^3/d	275 gpm (24 hr)	Volume of water needing to be percolated (above summer LAD capacity)
Volume of water: winter snowmaking (hydraulic evaporation included), $\mathbf{V_{W1}}$	38,406 ft^3/d	285 gpm (24 hr)	winter volume from LAD areas 3, 4, 6; maximum capacity
Winter volume of water applied: percolation, $\mathbf{V_{W2}}$	137,647 ft^3/d	715 gpm (24 hr)	winter volume from percolation; additional water needing disposal
projected summer closure salt concentration in ground water days 1-120 at $\mathbf{Z_s}$	535 mg/L	**834** µmhos/cm	projected **summer** concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) from LAD of treated adit plus tailings waters, days 1-120
projected winter closure salt concentration in ground water days 1-120 at $\mathbf{Z_W}$	486 mg/L	**759** µmhos/cm	projected **winter** concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) from LAD plus percolation of treated adit plus tailings waters, days 1-120
projected closure salt concentration in ground water days 121-365	379 mg/L	**591** µmhos/cm	projected concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) from percolation of treated adit water days 121-365

This Summer closure scenario of disposal of 1,450 gpm (12 hr) treated adit plus tailings waters at the East Boulder Mine LAD areas and percolation of 550 gpm (12 hr) treated adit plus tailings waters is projected to produce an EC in ground water less than the Beneficial Use criterion during closure, days 1-120. This Winter closure scenario of disposal of 570 gpm (12 hr) treated adit plus tailings waters at the East Boulder Mine LAD snowmaking areas and percolation of 1,430 gpm (12 hr) treated adit plus tailings waters is projected to produce an EC in ground water less than the Beneficial Use criterion during closure, days 1-120. The projected closure salt concentration in ground water days 121-365 is projected to produce an EC in ground water less than the Beneficial Use criterion.

East Boulder River Concentration near EBR-004/4A	**Summer Closure: LAD 1,450 gpm (12 hr) treated adit plus tailings waters and percolate 550 gpm (12 hr) treated adit plus tailings waters. Winter Closure: Snowmaking LAD 570 gpm (12 hr) treated adit plus tailings waters and percolate 1,430 gpm (12 hr) treated adit plus tailings waters.**

receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
summer discharge volume of ground water, days 1-120 $\mathbf{Q_{ds}}$	294,618 ft^3/d	3.4 cfs	ground water discharge volume in cubic feet per second; hydraulic evaporative losses taken in volume calculations
winter discharge volume of ground water, days 1-120 $\mathbf{Q_{dw}}$	269,427 ft^3/d	3.1 cfs	ground water discharge volume in cubic feet per second; hydraulic evaporative losses taken in volume calculations
closure discharge volume of ground water, days 121-365 $\mathbf{Q_{dw}}$	246,778 ft^3/d	2.9 cfs	ground water discharge volume in cubic feet per second; hydraulic evaporative losses taken in volume calculations
summer discharge concentration to East Boulder River, days 1-120 $\mathbf{C_{ds}}$	535 mg/L	834 µmhos/cm	projected **summer** concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) days 1-120 from LAD and percolation of treated adit plus tailings waters
winter discharge concentration to East Boulder River, days 1-120 $\mathbf{C_{dw}}$	486 mg/L	759 µmhos/cm	projected **winter** concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) days 1-120 from snowmaking LAD and percolation of treated adit plus tailings waters
closure discharge concentration to the East Boulder River, days 121-365 , $\mathbf{C_d}$	379 mg/L	591 µmhos/cm	projected concentration of salt (EC) in ground water just prior to discharging to East Boulder River (at SP-11) days 121-365 from percolation of adit water days 121-335
projected summer closure East Boulder River salt concentration, days 1-120	**246 mg/L**	383 µmhos/cm	projected **summer** concentration of salt (TDS) in the East Boulder River at EBR-004/004A from LAD and percolation of treated adit plus tailings waters days 1-120
projected winter closure East Boulder River salt concentration, days 1-120	**217 mg/L**	338 µmhos/cm	projected **winter** concentration of salt (TDS) in the East Boulder River at EBR-004/004A from LAD and percolation of treated adit plus tailings waters days 1-120
projected closure salt concentration in the East Boulder River days 121-365	**169 mg/L**	263 µmhos/cm	projected closure concentration of salt (TDS) in the East Boulder River at EBR-004/004A from percolation of treated adit water days 121-365

This Summer closure scenario of disposal of 1,450 gpm (12 hr) treated adit plus tailings waters at the East Boulder Mine LAD areas and percolation of 550 gpm (12 hr) treated adit plus tailings waters is projected to produce a TDS concentration in the East Boulder River less than the 250 mg/L recommendation to protect trout eggs during closure. This Winter closure scenario of disposal of 570 gpm (12 hr) treated adit plus tailings waters at the East Boulder Mine LAD snowmaking areas and percolation of 1,430 gpm (12 hr) treated adit plus tailings waters is projected to produce a TDS concentration less than the 250 mg/L recommendation to protect trout eggs during closure.

Proposed Alternative 2B, Option 1, 150 gpm: Up to 150 gpm (24 hr) adit water and 232 gpm (24 hr) East Boulder tailings waters would be mixed and treated in the BTS/Anox system for nitrogen. The mixed treated waters would be preferentially disposed at the East Boulder Mine percolation pond. The time frame for closure is 12 months.

median adit EC calculated from SMC monitoring data	858 µmhos/cm	550 mg/L	median adit TDS concentration derived from SMC monitoring data
median tailings waters EC calculated from SMC monitoring data	1,332 µmhos/cm	854 mg/L	median tailings waters TDS concentration derived from SMC monitoring data
		150 gpm (24 hr)	**adit** flow rate at closure
		232 gpm (24 hr)	**tailings waters** pumping rate at closure
		735 mg/L	weighted average concentration of TDS in mixed treated adit plus tailings waters
East Boulder Hydraulic Loading Input Parameters, closure		120 days	time to dewater the tailings impoundment
East Boulder Tailings impoundment discharge volume	40 MG	**464** gpm (12 hr)	rate to dewater the impoundment
24 hr rate to dewater East Boulder tailings impoundment	**232** gpm (24 hr)	28,877 ft^3/d	volume of adit water in cubic feet per day
volume of water from East Boulder Tailings impoundment in cubic feet per day	44,663 ft^3/d	**300** gpm (12 hr)	adit flow rate
East Boulder Adit Flow rate	**150** gpm (24 hr)	**764** gpm (12 hr)	total flow rate to percolation
total flow rate to BTS/Anox	**382** gpm (24 hr)	**2,210** gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

The hydraulic load of 150 gpm adit waters plus 232 gpm East Boulder tailings impoundment waters can be managed at the East Boulder Mine percolation pond.

East Boulder MPDES Source-Specific (percolation pond) mixing zone calculations

Up to 150 gpm (24 hr) adit water and 232 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the East Boulder Mine percolation pond.

depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3,600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400 gpm		MPDES Statement of Basis, p. 25-26
upgradient/background concentration of TDS in ground water at WW-1, $\mathbf{C_A}$	106 mg/L	165 µmhos/cm	SMC Monitoring Data

angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977 ft^2		D * W, allowed by 17.30.517(d)
Volume of water percolated, days 1-120 $\mathbf{V_p}$	73,540 ft^3/d	**382** gpm (24 hr)	volume of percolated treated adit plus tailings waters, days 1-120
Volume of water percolated, days 121-365 $\mathbf{V_p}$	28,877 ft^3/d	**150** gpm (24 hr)	volume of percolated treated adit water days 121-365
concentration of salt in ground water at end of mixing zone days 1-120, $\mathbf{Z_s}$	413 mg/L	**644** µmhos/cm	projected salt concentration in ground water near EBMW-6 days 1-120, percolated adit plus tailing waters
concentration of salt in ground water at end of mixing zone days 121-365, $\mathbf{Z_s}$	227 mg/L	**354** µmhos/cm	projected salt concentration in ground water near EBMW-6 days 121-365, percolated adit water
concentration of salt in ground water near SP-11 days 1-120	389 mg/L	**607** µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River days 1-120 percolated adit plus tailing waters; uses assumed operational salt concentration in ground water from SMC monitoring data
closure concentration of salt in ground water near SP-11 days 121-365	274 mg/L	**427** µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River days 121-365 percolated adit water; uses assumed operational salt concentration in ground water from SMC monitoring data

Throughout the closure period, the salt concentration (EC) in ground water from the percolation of 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings water is projected to be less than the 1,000 µmhos/cm Beneficial Use Criterion.

East Boulder River Concentration near EBR-004/4A			**Up to 150 gpm (24 hr) adit water and 232 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the East Boulder Mine percolation pond.**
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
discharge volume of ground water days 1-120, $\mathbf{Q_d}$	178,436 ft^3/d	2.1 cfs	discharge volume of ground water in cubic feet per second, days 1-120
discharge volume of ground water days 121-365, $\mathbf{Q_d}$	105,882 ft^3/d	1.2 cfs	discharge volume of ground water in cubic feet per second, days 121-365
Concentration of ground water near SP-11, days 1-120 $\mathbf{C_d}$	389 mg/L	607 µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River; uses assumed operational concentration in ground water from 2000-2007 SMC Monitoring Data; days 1-120
Concentration of ground water near SP-11, days 121-365 $\mathbf{C_d}$	274 mg/L	427 µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River; uses assumed operational concentration in ground water from 2000-2007 SMC Monitoring Data; days 121-365
projected East Boulder River salt concentration days 1-120	**148 mg/L**	231 µmhos/cm	projected salt concentration in the East Boulder River near EBR-004/004A from percolation of treated adit plus tailings waters days 1-120
projected East Boulder River salt concentration days 121-365	**93 mg/L**	145 µmhos/cm	projected salt concentration in the East Boulder River near EBR-004/004A from percolation of treated adit water days 121-365

Throughout the closure period, the TDS concentration in the East Boulder River from the percolation of 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings water is projected to be less than the 250 mg/L recommendation for the protection of trout eggs.

Proposed Alternative 2B, Option 2, 150 gpm: The 150 gpm (24 hr) adit water plus 232 gpm (24 hr) tailings waters would be treated and routed for disposal at the East Boulder Mine LAD Area 6 (LAD Areas 2, 3-Upper, and 4 would not be built.) The time frame for closure would be 12 months.

East Boulder MPDES Source-Specific (percolation pond) mixing zone calculations			**Up to 150 gpm (24 hr) adit water and 232 gpm (24 hr) East Boulder tailings would be treated in the BTX/Anox system for nitrogen then preferentially disposed at the East Boulder Mine LAD Area 6.**
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW, $\mathbf{Q_1}$	400 gpm		MPDES Statement of Basis, p. 25-26
upgradient/background concentration of TDS in ground water at WW-1, $\mathbf{C_A}$	106 mg/L		CES 2008 Apdx D, East Boulder Mine TDS Table p 2, central value upgradient wells
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)

area of mixing zone, **A_1**	55977	ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing **Q_2**=kiA	27,891	ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
median concentration of TDS in ground water below percolation pond at EBMW-6, **C_2**	**259**	mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
effective concentration of salt applied during Summer and Winter LAD (hydraulic evaporation; no salts treatment credit)	**1,049**	mg/L		salt concentration factor of 30% from evaporation for both LAD and snowmaking at LAD Area 6
East Boulder Hydraulic Loading Input Parameters, closure				**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD summer and winter rates, with percolation of the excess treated mixed water.**
East Boulder Tailings impoundment discharge volume	40	MG	120 days	time to dewater the tailings impoundment; length of one LAD season
rate to dewater East Boulder tailings impoundment	**232**	gpm (24 hr)	464 gpm (12 hr)	rate to dewater the impoundment
volume of East Boulder **tailings waters** per day	44,663	ft^3/d	28,877 ft^3/d	volume of **adit water** in cubic feet per day
East Boulder adit flow rate	**150**	gpm (24 hr)	300 gpm (12 hr)	East Boulder adit flow rate
total combined flow rate of adit plus East Boulder tailings waters	**382**	gpm (24 hr)	**764** gpm (12 hr)	total combined flow rate of adit plus East Boulder tailings waters
Summer LAD Area 6 maximum hydraulic load	56,406	ft^3/d	**586** gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
summer volume of adit plus tailings waters to be disposed	73,540	ft^3/d	**764** gpm (12 hr)	**summer volume of adit plus tailings waters to be disposed**
Summer excess volume of water needing disposal	17,134	ft^3/d	**178** gpm (12 hr)	**Summer excess volume of water needing disposal; assume percolation**

For a closure scenario that commences in Summer, there is insufficient hydraulic capacity at LAD Area 6 to manage 150 gpm (24 hr) treated adit plus 232 gpm (24 hr) treated tailings waters during the 120 day LAD season. Additional handling measures such as percolation must be used. These volumes of adit water and tailings waters can be managed at the East Boulder Mine using both LAD and percolation during a 12 month closure scenario.

Winter LAD Area 6 snowmaking maximum hydraulic load	39,465	ft^3/d	**410** gpm (12 hr)	snowmaker maximum total flow rate, 10.2 ac (CES 2008)
winter volume of adit plus tailings waters to be disposed	73,540	ft^3/d	**764** gpm (12 hr)	**winter volume of adit plus tailings waters to be disposed**
winter excess volume of water needing disposal	34,075	ft^3/d	**354** gpm (12 hr)	**Winter excess volume of water needing disposal; assume percolation**

For a closure scenario that commences in Winter, there is insufficient hydraulic capacity at LAD Area 6 to manage 150 gpm (24 hr) treated adit plus 232 gpm (24 hr) treated tailings waters during the 120 day LAD season. Additional handling measures such as percolation must be used. These volumes of adit water and tailings waters can be managed at the East Boulder Mine using both LAD and percolation during a 12 month closure scenario.

Proposed Alternative 2B Option 3, 150 gpm: Maximize LAD for treated adit and tailings waters at LAD Area 6; LAD areas 2, 3-Upper, and 4 would not be built. Dispose of excess waters at the East Boulder Mine percolation pond. The time frame for closure would be 12 months.

East Boulder Salt Loading Input Parameters, closure				**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD Area 6 summer and winter rates, with percolation of the excess treated mixed water.**
Summer LAD Salts load to soil from East Boulder Mine Site, LAD area 6 days 1-120	2,583	lbs/day	**586** gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Closure summer LAD salt load to soil	309,262	lbs/yr	30,320 lbs/ac/yr	**closure summer LAD salt load per acre of soil**
Summer closure salts load to ground water from percolation, 365 days	336,755	lbs/yr	0.7 lbs/ft^2/yr	closure summer LAD salt load per square foot of soil per year
Winter Snowmaking Salts load to soil from East Boulder Mine site, LAD area 6 days 1-120	1,807	lbs/day	**410** gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Closure winter LAD salt load to soil	216,378	lbs/yr	21,213 lbs/ac/yr	**closure winter LAD salt load per acre of soil**
Winter closure salts load to ground water from percolation, 365 days	429,639	lbs/yr	0.5 lbs/ft^2/yr	closure winter LAD salt load per square foot of soil per year
weighted average concentration of TDS in mixed treated adit plus tailings waters	735	mg/L	10.2 ac	LAD Area 6
median adit TDS concentration derived from SMC monitoring data	550	mg/L	813 µmhos/cm	median adit TDS concentration derived from SMC monitoring data
median East Boulder tailings water TDS concentration derived from SMC monitoring data	854	mg/L	1,366 µmhos/cm	median tailings waters TDS concentration derived from SMC monitoring data
volume of water from East Boulder Tailings impoundment per day	44,663	ft^3/d	28,877 ft^3/d	volume of adit water in cubic feet per day

weighted average concentration of TDS in mixed treated adit plus tailings waters at closure, days 1-120	735 mg/L	550 mg/L	concentration of TDS in treated adit water at closure, days 121-365
projected summer concentration of salt in ground water at end of mixing zone, days 1-120, Z_s	300 mg/L	**467** µmhos/cm	projected summer concentration of salt in ground water near EBMW-6 and EBMW-7 from percolation of treated adit plus tailings waters
projected summer concentration of salt in ground water near SP-11, days 1-120	566 mg/L	**883** µmhos/cm	projected summer concentration of salt in ground water near SP-11 just prior to discharge to the East Boulder River from percolation plus LAD
projected winter concentration of salt in ground water at end of mixing zone days 1-120, Z_s	401 mg/L	**626** µmhos/cm	projected winter concentration of salt in ground water near EBMW-6 and EBMW-7 from percolation of treated adit plus tailings waters
projected winter concentration of salt in ground water near SP-11, days 1-120	541 mg/L	**843** µmhos/cm	projected winter concentration of salt in ground water near SP-11 just prior to discharge to the East Boulder River from percolation plus LAD
projected closure concentration of salt in ground water near SP-11 days 121-365	234 mg/L	**365** µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River days 121-365 percolated adit water; uses assumed operational salt concentration in ground water from SMC monitoring data

Throughout the closure period, the salt concentration (EC) in ground water from the LAD and percolation of 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings water is projected to be less than the 1,000 µmhos/cm Beneficial Use Criterion.

East Boulder River Concentration below LAD area			**Disposal of up to 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings waters at the maximum LAD summer and winter rates, with percolation of the excess treated mixed water.**
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
summer closure discharge volume of ground water days 1-120, $\mathbf{Q_d}$	218,132 ft^3/d	2.5 cfs	summer discharge volume of ground water in cubic feet per second, days 1-119
winter closure discharge volume of ground water days 1-120, $\mathbf{Q_d}$	228,297 ft^3/d	2.6 cfs	winter discharge volume of ground water in cubic feet per second, days 1-120
closure discharge volume of ground water days 121-365, $\mathbf{Q_d}$	133,773 ft^3/d	1.5 cfs	closure discharge volume of ground water in cubic feet per second, days 121-365
summer projected concentration of ground water near SP-11, days 1-120 $\mathbf{C_d}$	566 mg/L	883 µmhos/cm	projected summer concentration of salt in ground water near SP-11 just prior to discharge to the East Boulder River from percolation plus LAD
winter projected concentration of ground water near SP-11, days 1-120 $\mathbf{C_d}$	541 mg/L	843 µmhos/cm	projected winter concentration of salt in ground water near SP-11 just prior to discharge to the East Boulder River from percolation plus LAD
cosure concentration of ground water near SP-11, days 121-365, $\mathbf{C_d}$	234 mg/L	365 µmhos/cm	projected salt concentration in ground water near SP-11 just prior to discharge to the East Boulder River days 121-365 percolated adit water; uses assumed operational salt concentration in ground water from SMC monitoring data
projected summer salt concentration in the East Boulder River, days 1-120	**222 mg/L**	347 µmhos/cm	projected **summer** concentration of salt (TDS) in the East Boulder River at EBR-004/004A from LAD and percolation of treated adit plus tailings waters days 1-120
projected winter salt concentration in the East Boulder River, days 1-120	**219 mg/L**	µmhos/cm	projected **winter** concentration of salt (TDS) in the East Boulder River at EBR-004/004A from LAD and percolation of treated adit plus tailings waters days 1-120
projected closure salt concentration in the East Boulder River days 121-365	**92 mg/L**	µmhos/cm	projected closure concentration of salt (TDS) in the East Boulder River at EBR-004/004A from percolation of treated adit water days 121-365

Throughout the closure period, the TDS concentration in the East Boulder River from the percolation of 150 gpm (24 hr) treated adit water plus 232 gpm (24 hr) treated tailings water is projected to be less than the 250 mg/L recommendation for the protection of trout eggs.

Spreadsheet 3B Nitrogen--Agency-Mitigated Alternative 3B East Boulder Closure Nitrogen Analyses

The agencies' preferred disposal of treated adit waters is at the mine site LAD areas and then at the percolation pond. For the East Boulder Mine, the calculations have been made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer (no unsaturated zone was considered). To determine the concentration of total inorganic nitrogen (TIN) in ground water, it was assumed that all ground water flow parallels the East Boulder River and enters the river at a point at, or just downstream of, the permit boundary. Tailings impoundment waters would be treated and routed the same as adit water. The East Boulder Mine MPDES permit has a source-specific mixing zone for the percolation pond that enters the aquifer flowing beneath the tailings impoundment. The MPDES permit calculations do not allow evaporation credit in discharge to percolation. For the PoleCat evaporators and center pivots, the agencies assume 30% evaporation. For the PoleCat snowmakers, the agencies assume 30% evaporation in winter. The MPDES permitted annual average 30 pounds/day TIN limit. The water disposal design capacities cited below are from CES 2008. The East Boulder Mine is required by the MPDES permit to maintain the 30 pound/day average total inorganic nitrogen limit, regardless of inflow nitrogen concentrations. The existing treatment systems would be increased to meet hydraulic and TIN treatment requirements. All waters are treated prior to discharge. All forms of total inorganic nitrogen treatment, such as evaporation, LAD, and BTS/Anox are included to accomplish the 30 pound/day MPDES total inorganic nitrogen permit limit.

Agency-Mitigated Alternative 3B, Option 1, 737 gpm: This option evaluates the inflexibility of the East Boulder Mine Proposed Action Alternative 2B 12-month closure period. This option would percolate the entire treated 737 gpm (24 hr) adit flow with the maximum volume of treated tailings waters that would meet the 30 lbs/day MPDES permit nitrogen limit. The 737 gpm (24 hr) treated adit water and 83 gpm (24 hr) of East Boulder tailings waters would be mixed and treated in the BTS/Anox system. All 820 gpm (24 hr) would be disposed in the East Boulder Mine percolation pond as in Proposed Action Alternative 2B. The time frame for closure would be 18 months.

For all options analyzed in this spreadsheet:			20	pounds/day	Historical maximum load from BTS/Anox system at East Boulder Mine
BTS/Anox system assumed to treat nitrogen at 1,000 gpm (24 hr) rate			**737**	gpm (24 hr)	adit flow rate at closure (24 hr rate)
Percolation pond can accommodate at least 1,000 gpm (24 hr) rate			**83**	gpm (24 hr)	East Boulder tailings pumping rate at closure
			2.3	mg/L	treated total inorganic nitrogen concentration of adit waters
untreated total inorganic nitrogen concentration of adit waters	50	mg/L	10	mg/L	Current BTS/Anox end of pipe treatment efficiency of 80% for tailings water
East Boulder Percolation total inorganic nitrogen Loading, closure			3.0	mg/L	weighted average post BTS/Anox concentration of adit water and tailings water
East Boulder Tailings Impoundment discharge volume	40	MG	**335**	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**737**	gpm (24 hr)	1,474	gpm (12 hr)	adit flow rate
total combined adit plus East Boulder tailings waters flow needing disposal	820	gpm (24 hr)	1,640	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
total inorganic nitrogen load of treated adit plus tailings waters percolated	**30.0**	lbs/day	2,210	gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4
Total total inorganic nitrogen load to ground water during 18-month closure	**14,774**	lbs/18-mos			

Disposal of adit and tailings waters using only percolation meets the MPDES permit 30 pound/day total inorganic nitrogen limit.

Agency-Mitigated Alternative 3B, Option 2, 737 gpm: The 737 gpm (24 hr) of treated adit water and 83 gpm (24 hr) of treated East Boulder tailings waters would be preferentially disposed of at the East Boulder Mine LAD areas during an 18-month closure period. All approved LAD areas would be constructed. No water would be discharged to the mine percolation pond.

East Boulder LAD Areas 2, 3-Upper, 4, and 6 Hydraulic Loading, closure			**LAD of 737 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Areas 2, 3-Upper, 4, and 6; no percolation would be used**		
East Boulder Tailings Impoundment discharge volume	40	MG	**335**	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
East Boulder Adit Flow rate	**737**	gpm (24 hr)	1,474	gpm (12 hr)	Adit Flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**820**	gpm (24 hr)	**1,640**	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	293	gpm (24 hr)	**1,450**	gpm (12 hr)	hydraulic capacity of all East Boulder Mine LAD Areas
Summer LAD Area 6 maximum hydraulic load	56,406	ft^3/d	586	gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer LAD Area 4 maximum hydraulic load	26,952	ft^3/d	280	gpm (12 hr)	evaporator maximum flow rate, 11.2 ac (CES 2008)
Summer LAD Area 3 Upper maximum hydraulic load	26,952	ft^3/d	280	gpm (12 hr)	evaporator maximum flow rate, 11.3 ac (CES 2008)

Summer LAD Area 2 maximum hydraulic load	29,262 ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer total hydraulic load	139,572 ft^3/d	**190** gpm (12 hr)	**Summer excess volume of water that must be percolated**
Summer area available for LAD	46.6 ac	32.7 ac	**Winter** area available for LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465 ft^3/d	410 gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter LAD Area 4 snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac (CES 2008)
Winter LAD Area 3 Upper snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate 11.3 ac (CES 2008)
Winter total hydraulic load	54,866 ft^3/d	**1,070** gpm (12 hr)	**Winter excess volume of water that must be percolated**

The hydraulic load of 737 gpm adit water plus 83 gpm East Boulder tailings waters exceeds the capacity of the approved LAD areas in summer and winter and cannot be managed solely by land application at East Boulder Mine; some excess waters must be percolated.

Agency-Mitigated Alternative 3B, Option 3, 737 gpm: The 737 gpm (24 hr) of adit water and 83 gpm of tailings waters would be treated and preferentially disposed at the mine LAD areas during an 18-month closure period. All approved LAD areas would be constructed. Excess treated waters would be discharged to the East Boulder Mine percolation pond.

		20 pounds/day	Historical maximum load from BTS/Anox system at East Boulder Mine
		737 gpm (24 hr)	adit flow rate at closure
		83 gpm (24 hr)	tailings flow rate at closure; fixed by BTS/Anox system treatment rate 1000 gpm
length of LAD season	120 days	2.3 mg/L	treated total inorganic nitrogen conc of adit waters based on historical BTS/Anox treatment and flow rate
		10 mg/L	Current BTS/Anox end of pipe treatment efficiency of 80% for tailings water (50 mg/L)
East Boulder MPDES Source-Specific (percolation pond) mixing zone calculations		3 mg/L	weighted average post BTS/Anox concentration of adit water and tailings water
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26;
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to compliance wells EBMW-6 and EBMW-7, L_1	3,600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400 gpm		MPDES Statement of Basis, p. 25-26
ambient concentration of total inorganic nitrogen in ground water, C_A	0.15 mg/L		MPDES Statement of Basis, p. 24
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, W_1	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_1	55,977 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing Q_1=kiA	77,005 ft^3/d		calculation per 17.30.517(d);
Volume of ground water available for mixing Q_2=kiA_2	27,914 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
depth of aquifer, D_2	15 ft		allowed by 17.30.517(d)
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, L_2	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of zone, W_2	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)

area of mixing zone, A_2	14,303 ft^2		D * W, allowed by 17.30.517(d)
median total inorganic nitrogen concentration in ground water below percolation pond at EBMW-6, C_2	1 mg/L		median total inorganic nitrogen value at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
East Boulder Hydraulic Loading Input Parameters, closure		**LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas during the 120 day LAD season with percolation of the excess water at the mine percolation pond for the remainder of closure**	
East Boulder Tailings Impoundment discharge volume	40 MG	**335** days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83** gpm (24 hr)	**166** gpm (12 hr)	rate to dewater the East Boulder tailings impoundment
East Boulder Adit Flow rate	**737** gpm (24 hr)	**1,474** gpm (12 hr)	adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**820** gpm (24 hr)	**1,640** gpm (12 hr)	total combined hydraulic load (adit plus East Boulder tailings waters)
Summer LAD Area 6 maximum hydraulic load	56,406 ft^3/d	586 gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer LAD Area 4 maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.2 ac (CES 2008)
Summer LAD Area 3-Upper maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.3 ac (CES 2008)
Summer LAD Area 2 maximum hydraulic load	29,262 ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer total hydraulic load	139,572 ft^3/d	1,450 gpm (12 hr)	hydraulic capacity of all LAD areas
Summer area available for LAD	46.6 ac	32.7 ac	**Winter** area available for LAD
Summer total inorganic nitrogen load **to soil** for microbial degradation and plant uptake Days 1-120	21.2 lbs/day	5.3 lbs/day	**Summer** total total inorganic nitrogen load **to ground water** from LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465 ft^3/d	410 gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter LAD Area 4 snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac (CES 2008)
Winter LAD Area 3 Upper snowmaking maximum hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate 11.3 ac (CES 2008)
Winter total hydraulic load	54,866 ft^3/d	570 gpm (12 hr)	maximum hydraulic snowmaking load at all LAD areas
Winter total inorganic nitrogen load **to ground water** after evaporation and snowmaking Days 1-120	3.9 lbs/day	1,070 gpm (12 hr)	assume excess water is percolated
Summer volume of excess water that must be percolated **Days 1-120**	**95** gpm (24 hr)	**535** gpm (24 hr)	**Winter** volume of excess water that must be percolated **Days 1-120**
volume of water that must be percolated **Days 121-335**	820 gpm (24 hr)	737 gpm (24 hr)	volume of water that must be percolated **Days 336-548**
Summer percolation total inorganic nitrogen load **to ground water days 1-120**	3.5 lbs/day	19.5 lbs/day	**Winter** percolation total inorganic nitrogen load **to ground water Days 1-120**
Summer total (LAD plus percolation) total inorganic nitrogen load **to ground water days 1-120**	**8.8** lbs/day	**23.5** lbs/day	**Winter total** (Snowmaking plus percolation) total inorganic nitrogen load **to ground water Days 1-120**
days 121-335 total inorganic nitrogen load **to ground water**	**22.3** lbs/day	**20.0** lbs/day	**days 336-548** total inorganic nitrogen load **to ground water**
Total total inorganic nitrogen **load to ground water** during closure that commences in **summer**	11,118 lbs/18 mos	13,047 lbs/18 mos	**Total** total inorganic nitrogen **load to ground water** during closure that commences in **winter**

For a closure that commences in summer, up to 737 gpm (24 hr) treated adit water and 83 gpm (24 hr) treated tailings waters can be LAD at a rate of 1,450 gpm (12 hr) with percolation of up to 95 gpm (24 hr), the hydraulic capacity of the LAD areas and percolation pond are not exceeded. For a closure that commences in winter, up to up to 737 gpm (24 hr) treated adit water and 83 gpm (24 hr) treated tailings waters can be disposed by snowmaking at a rate of 570 gpm (24 hr) with percolation of up to 535 gpm (24 hr), the hydraulic capacity of the LAD areas and percolation pond are not exceeded.

Appendix C
DEQ 2010

The MPDES permit 30 lbs/day total inorganic nitrogen limit is met for closure that commences in summer or winter, and during percolation of treated adit water during the remainder of the closure period.

Ground Water Inputs East Boulder Mine LAD areas			**LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas with percolation of the excess water at the mine percolation pond**		
depth of aquifer, $\mathbf{D_2}$	15	ft	3	mg/L	weighted average post BTS/anox concentration of adit water and tailings water
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	700	ft			MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	109,156	ft^3/d			calculation per 17.30.517(d);
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA$_2$	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
median operational total inorganic nitrogen concentration in ground water below percolation pond at EBMW-6 from SMC Monitoring data 2000-2007 (pre-spill), $\mathbf{C_2}$	1	mg/L	0.9	mg/L	total inorganic nitrogen concentration in LAD waters, 80% nitrogen credit applied (post plant uptake and snowmaking), $\mathbf{C_2}$
concentration of total inorganic nitrogen in ambient ground water, $\mathbf{C_A}$	0.15	mg/L			MPDES Statement of Basis, p. 24
Volume of water: summer LAD (evaporation credit applied), $\mathbf{V_{S1}}$	97,701	ft^3/d	508	gpm (24 hr)	summer volume from LAD areas 2, 3, 4, 6 (evaporation credit applied)
Volume of water percolated in summer (no evaporation or treatment credit), $\mathbf{V_{S2}}$	18,289	ft^3/d	95	gpm (24 hr)	summer volume from percolation; excess water needing disposal days 1-120
Volume of water: winter snowmaking (evaporation credit applied), $\mathbf{V_{W1}}$	38,406	ft^3/d	200	gpm (24 hr)	winter volume from LAD areas 3, 4, 6 (evaporation credit applied)
Volume of water percolated in winter (no evaporation or treatment credit), $\mathbf{V_{W2}}$	102,995	ft^3/d	535	gpm (24 hr)	winter volume from percolation; excess water needing disposal days 1-120
Volume of water that is percolated after the LAD season days 121-335	157,861	ft^3/d	820	gpm (24 hr)	adit plus tailings waters until impoundment is dewatered Days 121-335
Volume of adit water percolated for remainder of closure period days 336-548	141,882	ft^3/d	737	gpm (24 hr)	adit water; to end of closure period days 336-548
Summer total inorganic nitrogen concentration in ground water, **Days 1-120** $\mathbf{Z_1}$	**0.7**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Summer total inorganic nitrogen concentration in ground water, **Days 121-355,** $\mathbf{Z_2}$	**1.8**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Summer total inorganic nitrogen concentration in ground water, **Days 336-548** $\mathbf{Z_3}$	**1.4**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Winter total inorganic nitrogen concentration in ground water, **Days 1-120** $\mathbf{Z_1}$	**1.4**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Winter total inorganic nitrogen concentration in ground water, **Days 121-335,** $\mathbf{Z_3}$	**1.8**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Winter total inorganic nitrogen concentration in ground water, **Days 336-548** $\mathbf{Z_3}$	**1.4**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11

Total inorganic nitrogen concentrations in ground water in both of these summer and winter closure scenarios meet the DEQ-7 nitrogen ground water standard of 10 mg/L.

East Boulder River Concentration below LAD area at Closure					**LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas with percolation of the excess water at the mine percolation pond; the highest seasonal total inorganic nitrogen concentration in ground water was used for this calculation**
receiving streamflow, $\mathbf{Q_s}$	432,000	ft^3/d	5	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	0.15	mg/L			MPDES Statement of Basis, p. 24
discharge volume of ground water corresponding to Summer days 121-335, $\mathbf{Q_{d2}}$	294,908	ft^3/d	3.5	cfs	credit for evaporative losses taken in volume calculations
discharge volume of ground water corresponding to Winter days 121-335, $\mathbf{Q_{d2}}$	294,908	ft^3/d	3.5	cfs	
lowest discharge total inorganic nitrogen concentration of ground water	0.7	mg/L			
highest summer discharge total inorganic nitrogen concentration of ground water , $\mathbf{C_{ds}}$	1.8	mg/L			based on projected winter concentration of ground water near SP-11 days 121-335
highest winter discharge total inorganic nitrogen concentration of ground water, $\mathbf{C_{dw}}$	1.8	mg/L			
projected East Boulder River total inorganic nitrogen concentration in Summer days 1-120	**0.4**	**mg/L**	based on the **lowest** total inorganic nitrogen concentration in ground water just prior to discharge to the East Boulder River, su		
projected East Boulder River total inorganic nitrogen concentration in Summer days 121-335	**0.8**	**mg/L**	based on the **highest summer** total inorganic nitrogen concentration in ground water just prior to discharge to the East Boulde		
projected East Boulder River total inorganic nitrogen concentration in Winter days 121-335	**0.8**	**mg/L**	based on the **highest winter** total inorganic nitrogen concentration in ground water just prior to discharge to the East Boulder F		

The total inorganic nitrogen concentration produced during these summer and winter closure options meet the MPDES permit criteria of 1 mg/L for the East Boulder River

Agency-Mitigated Alternative 3B, Option 1, 150 gpm: This option evaluates the feasibility of the East Boulder Mine WMP Proposed Action Alternative 2B 12-month closure period. This option would percolate the entire treated 150 gpm of adit water with the maximum volume of treated East Boulder tailings waters that would meet the 30 lbs/day MPDES permit nitrogen limit. The 150 gpm adit and 83 gpm tailings waters would be treated in the BTS/Anox system and be preferentially disposed in the mine percolation pond during the closure period. No water would be land applied at closure.

			20	pounds/day	Historical maximum load from BTS/Anox system at East Boulder Mine
			150	gpm (24 hr)	adit flow rate at closure
			83	gpm (24 hr)	tailings flow rate at closure; fixed by pumping rate
			11.1	mg/L	treated concentration of adit waters based on historical maximum nitrogen load
			10.0	mg/L	Current BTS/Anox end of pipe treatment efficiency of 80% for tailings water
East Boulder Percolation total inorganic nitrogen Loading, closure			10.7	mg/L	weighted average post BTS/Anox concentration of adit water and tailings water flows
East Boulder Tailings Impoundment discharge volume	40	MG	**335**	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
East Boulder Adit Flow rate	**150**	gpm (24 hr)	300	gpm (12 hr)	Adit Flow rate
total combined flow (adit plus East Boulder tailings waters)	**233**	gpm (24 hr)	466	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer and Winter total inorganic nitrogen load of all treated adit and tailings waters disposed at the percolation pond	**30.0**	lbs/day	14,293	lbs/18 months	**Summer and Winter closure total inorganic nitrogen load of all treated adit and tailings waters disposed at the percolation pond, days 1-548**

Disposal of 150 gpm adit and 83 gpm tailings waters using only percolation meets the MPDES permit 30 pound/day total inorganic nitrogen limit.

East Boulder Hydraulic Loading Calculations, Percolation Pond					**Percolation of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond.**
East Boulder Tailings Impoundment discharge volume	40	MG	335	**days**	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
volume of water from East Boulder Tailings impoundment per day	15,979	ft^3/d	28,877	ft^3/d	volume of adit water per day
East Boulder Adit Flow rate	**150**	gpm (24 hr)	300	gpm (12 hr)	adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233**	gpm (24 hr)	**466**	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Volume of adit plus tailings waters to be percolated in cubic feet per day	44,856	ft^3/d	2,210	gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

The volume of treated adit plus tailings waters needing disposal is within the hydraulic capacity of the percolation pond.

Agency-Mitigated Alternative 3B, Option 2, 150 gpm: The 150 gpm (24 hr) of adit water would be treated with 83 gpm (24 hr) of East Boulder tailings waters and be preferentially disposed at the East Boulder Mine LAD Area 6 during the closure period. No other LAD areas would be built. No percolation would be used.

East Boulder LAD Area 6 Hydraulic Loading, closure					**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; no percolation would be used**
East Boulder Tailings Impoundment discharge volume	40	MG	**335**	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150**	gpm (24 hr)	300	gpm (12 hr)	East Boulder adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233**	gpm (24 hr)	466	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	293	gpm (24 hr)	586	gpm (12 hr)	hydraulic capacity of East Boulder Mine LAD Area 6
Summer hydraulic load that must be **percolated**	0	ft^3/d	**0**	gpm (12 hr)	**Summer** excess volume of water that must be **percolated**
Summer area available for LAD	46.6	ac	32.7	ac	Winter area available for LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465	ft^3/d	410	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter hydraulic load of water that must be **percolated**	5,390	ft^3/d	**56**	gpm (12 hr)	**Winter** excess volume of water that must be **percolated**

The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters can be managed at LAD Area 6 during closure that commences in summer. The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters cannot be managed solely at LAD Area 6 during closure that commences in winter; percolation must be used to dispose of 56 gpm (24 hr).

Agency-Mitigated Alternative 3B, Option 3, 150 gpm: The 150 gpm (24 hr) of adit water would be treated with 83 gpm (24 hr) of East Boulder tailings waters and be preferentially disposed at the East Boulder Mine LAD Area 6 during the closure period, with excess waters percolated at the mine pond. No other LAD areas would be built.

East Boulder LAD Area 6 Hydraulic Loading, closure					**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated**
East Boulder Tailings Impoundment discharge volume	40	MG	**335**	days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166	gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150**	gpm (24 hr)	300	gpm (12 hr)	East Boulder adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233**	gpm (24 hr)	466	gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	10	gpm (24 hr)	586	gpm (12 hr)	hydraulic capacity of East Boulder Mine LAD Area 6
Summer hydraulic load that must be **percolated**	0	ft^3/d	**0**	gpm (12 hr)	**Summer** excess volume of water that must be **percolated**
Summer area available for LAD	46.6	ac	32.7	ac	Winter area available for LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465	ft^3/d	410	gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter hydraulic load of water that must be **percolated**	5,390	ft^3/d	**56**	gpm (12 hr)	**Winter** excess volume of water that must be **percolated**

The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters can be managed using LAD Area 6 and the percolation pond during closure.

East Boulder LAD Area 6 total inorganic nitrogen Loading, closure					LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated
Summer total inorganic nitrogen load to ground water disposed at **LAD Area 6**, days 1-120	7.5	lbs/day	5.3	lbs/day	**Winter total inorganic nitrogen** load to ground water disposed at **LAD Area 6,** days 1-120
Summer total inorganic nitrogen load **percolated** days 1-120	0	lbs/day	3.6	lbs/day	**Winter** total inorganic nitrogen load **percolated** days 1-120
Summer Total total inorganic nitrogen load, days 1-120	**7.5**	lbs/day	**8.9**	lbs/day	**Winter Total** total inorganic nitrogen load, days 1-120
total inorganic nitrogen load percolated, days 121-335	**30.0**	lbs/day	**20.0**	lbs/day	total inorganic nitrogen load percolated, days 336-548
Summer closure total inorganic nitrogen load to ground water, days 1-548	**11,606**	lbs/18 mos	**11,766**	lbs/18 mos	**Winter closure** total inorganic nitrogen load to ground water, days 1-548

Disposal of 150 gpm adit and 83 gpm tailings waters using land application at LAD Area 6 and winter percolation meets the MPDES permit 30 lbs/day total inorganic nitrogen limit.

Ground Water Mixing Inputs Below East Boulder Mine LAD Area 6, at Closure

depth of aquifer, $\mathbf{D_2}$	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	700	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Statement of Basis, p. 25-26
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	109,156	ft^3/d	**3.1**	mg/L	concentration of total inorganic nitrogen in land applied waters; 80% nitrogen treatment credit applied,$\mathbf{C_2}$
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA_2	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
concentration of total inorganic nitrogen in treated adit plus tailings waters,$\mathbf{C_1}$	**10.7**	mg/L			calculated above
concentration of total inorganic nitrogen in ambient ground water, $\mathbf{C_A}$	0.15	mg/L			MPDES Statement of Basis, p. 24
median operational total inorganic nitrogen concentration in ground water below percolation pond at EBMW-6 from SMC Monitoring data 2000-2007 (pre-spill), $\mathbf{C_2}$	1	mg/L	**11.1**	mg/L	treated concentration of adit waters based on historical maximum nitrogen load
Volume of water: summer LAD days 1-120, $\mathbf{V_{S1}}$	39,484	ft^3/d	**410**	gpm (12 hr)	summer volume from LAD areas 6; 30% evaporation credit taken
Volume of water percolated in summer days 1-120, $\mathbf{V_{S2}}$	0	ft^3/d	**0**	gpm (24 hr)	Summer volume of excess water percolated
Volume of water: winter snowmaking days 1-120, $\mathbf{V_{W1}}$	27,626	ft^3/d	**287**	gpm (12 hr)	winter volume from LAD area 6; 30% evaporation credit taken
Volume of water percolated in winter days 1-120, $\mathbf{V_{W2}}$	5,390	ft^3/d	**56**	gpm (12 hr)	winter volume of excess water percolated
volume of water that must be percolated Days 121-335	44,856	ft^3/d	**233**	gpm (24 hr)	adit plus tailings waters until impoundment is dewatered Days 121-335
volume of water that must be percolated Days 336-548	28,877	ft^3/d	**150**	gpm (24 hr)	adit water to end of closure period days 336-548
Summer total inorganic nitrogen concentration in ground water, **Days 1-120** $\mathbf{Z_1}$	**0.9**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Summer total inorganic nitrogen concentration in ground water, **Days 121-355,** $\mathbf{Z_2}$	**2.9**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Summer total inorganic nitrogen concentration in in ground water, **Days 336-548** $\mathbf{Z_3}$	**2.4**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11

Winter total inorganic nitrogen concentration in ground water, **Days 1-120 Z_1**	**1.1**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Winter total inorganic nitrogen concentration in ground water, **Days 121-335, Z_3**	**2.9**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11
Winter total inorganic nitrogen concentration in in ground water, **Days 336-548, Z_3**	**2.5**	**mg/L**			projected concentration of total inorganic nitrogen in ground water near SP-11

Concentrations of total inorganic nitrogen in ground water are less than the DEQ-7 water quality standard of 10 mg/L.

East Boulder River Concentration below LAD area at Closure			**Only the lowest and highest total inorganic nitrogen concentrations in ground water were used for the following calculations.**		
receiving streamflow, $\mathbf{Q_s}$	432,000	ft^3/d	5	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_s}$	0.15	mg/L			MPDES Statement of Basis page 24
discharge volume of ground water corresponding to **Summer days 1-120, $\mathbf{Q_{dw}}$**	176,531	ft^3/d	2.1	cfs	volume corresponds to lowest projected ground water total inorganic nitrogen concentration,
discharge volume of ground water corresponding to **Summer days 121-335**, $\mathbf{Q_{ds}}$	181,902	ft^3/d	2.2	cfs	volume corresponds to highest projected ground water total inorganic nitrogen concentration,
discharge volume of ground water corresponding to **Winter days 1-120, $\mathbf{Q_{dw}}$**	170,063	ft^3/d	2.0	cfs	volume corresponds to lowest projected ground water total inorganic nitrogen concentration,
discharge volume of ground water corresponding to **Winter days 121-335, $\mathbf{Q_{dw}}$**	181,902	ft^3/d	2.2	cfs	volume corresponds to highest projected ground water total inorganic nitrogen concentration,
projected lowest summer discharge total inorganic nitrogen concentration of ground water	0.9	mg/L			projected concentration of total inorganic nitrogen in ground water near SP-11
projected **highest summer** discharge total inorganic nitrogen concentration of ground water , $\mathbf{C_{ds}}$	2.4	mg/L			projected concentration of total inorganic nitrogen in ground water near SP-12
projected **lowest winter** discharge total inorganic nitrogen concentration of ground water	1.1	mg/L			projected concentration of total inorganic nitrogen in ground water near SP-13
projected **highest winter** discharge total inorganic nitrogen concentration of ground water, $\mathbf{C_{dw}}$	2.9	mg/L			projected concentration of total inorganic nitrogen in ground water near SP-14
projected East Boulder River total inorganic nitrogen concentration in summer days 1-120	**0.4**	mg/L			days 1-120 **Summer** projected concentration of total inorganic nitrogen in the East Boulder River; **lowest**
projected East Boulder River total inorganic nitrogen concentration in winter days 121-335	**1.0**	mg/L			days 121-335 **Winter** projected concentration of total inorganic nitrogen in the East Boulder River; **highest**
projected East Boulder River total inorganic nitrogen concentration in winter days 1-120	**0.4**	mg/L			days 1-120 **Winter** projected concentration of total inorganic nitrogen in the East Boulder River; **lowest**
projected East Boulder River total inorganic nitrogen concentration in summer days 335-548	**0.8**	mg/L			days 121-335 **Summer** projected concentration of total inorganic nitrogen in the East Boulder River; **highest**

Spreadsheet 3B Salts: Agency-Mitigated Alternative 3B East Boulder Closure Salinity Analyses

The agencies' preferred manner of disposal of treated adit and tailings waters is at the East Boulder Mine LAD areas, then at the East Boulder Mine percolation pond. For the East Boulder Mine site, the calculation assumptions have been made according to the regulatory requirements of the existing MPDES permit, Montana Water Quality Act and Rules, and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the East Boulder Mine site LAD area, any water that percolates below the root zone is assumed to immediately enter the aquifer. The aquifer beneath the East Boulder mine site has Class I Beneficial Use (<1000 µmhos/cm). The MPDES permit does not set a limit for TDS or EC. The salts load is calculated from TDS. The calculations allow LAD evaporation credit for water volume only and do not allow treatment credit for salts. The calculations do not allow evaporation credit for percolation. No salts treatment occurs in BTS/Anox or LAD. Tailings impoundment waters would be routed the same as adit water. For hydraulic volume calculations, the PoleCat evaporators (summer) accomplish 30% evaporation, center pivots 30%; PoleCat (winter) 30% evapor-ation. The agencies have used the conversion factor of 1 mg/L TDS equating to 1.56 µmhos/cm. The concentrations of TDS or measured EC at spring SP-11 (downgradient of East Boulder Mine LAD area) are assumed to be representative of actual aquifer affected by applied mine waters. The agencies are using the 250 mg/L TDS concentration recommendation as protective of trout eggs. EC values are calculated from the TDS concentration to evaluate ground water quality standards.

Agency-Mitigated Alternative 3B, Option 1, 737 gpm: This option evaluates the feasibility of the East Boulder Mine Proposed Action Alternative 2B 12- month by extending the closure period. This option would percolate the entire treated 737 gpm (24 hr) adit flow with the maximum volume of treated tailings waters that would meet the 30 lbs/day would meet the 30 lbs/day MPDES permit nitrogen limit. The 737 gpm (24 hr) treatedadit water and 83 gpm (24 hr) of East Boulder tailings waters would be mixed and treated in the BTS/Anox system. All 820 gpm (24 hr) would be disposed in the East Boulder Mine percolation pond as in Proposed Action Alternative 2B. The time frame for closure would be 18 months.

for all of the calculations in this spreadsheet:	858 µmhos/cm	550 mg/L	median adit TDS concentration derived from SMC monitoring data
BTS/Anox system assumed to treat TIN at 1000 gpm rate	1,399 µmhos/cm	897 mg/L	median tailings waters TDS concentration (SMC monitoring data)
Percolation pond can accommodate at least 1000 gpm rate		**737** gpm (24 hr)	adit flow rate at closure
		83 gpm (24 hr)	tailings water pumping rate at closure (106 days)
	913 µmhos/cm	585 mg/L	weighted average TDS concentration of adit plus tailings waters at closure
East Boulder Hydraulic Loading Input Parameters, closure			
East Boulder Tailings Impoundment discharge volume	40 MG	**335 days**	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83** gpm (24 hr)	166 gpm (12 hr)	rate to dewater the impoundment
volume of water from East Boulder Tailings impoundment per day	15,979 ft^3/d	141,882 ft^3/d	volume of adit water per day
East Boulder Adit Flow rate days 1-548	**737** gpm (24 hr)	1,474 gpm (12 hr)	adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters) days 1-335	**820** gpm (24 hr)	1,640 gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Volume of adit plus tailings waters to be percolated in cubic feet per day	157,861 ft^3/d	2,210 gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

The volume of treated adit plus tailings waters needing disposal is within the hydraulic capacity of the percolation pond.

East Boulder MPDES permit source-specific (percolation pond) mixing zone calculations		**Percolation of 737 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond.**	
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, L_1	3,600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400 gpm		MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in ground water (avg at WW-1), C_A	106 mg/L	170 µmhos/cm	SMC Monitoring Data
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)

width of mixing zone, **W_1**	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, **A_1**	55,977 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing **Q_1**=kiA	77,005 ft^3/d	400 gpm	MPDES Statement of Basis, p.25-26
upgradient concentration of TDS in ground water (avg at WW-1), **C_A**	106 mg/L	165 µmhos/cm	MPDES Statement of Basis, p. 24
Volume of ground water available for mixing beneath LAD area **Q_2**=kiA	27,914 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
median concentration of TDS in ground water below percolation pond at EBMW-6, **C_2**	259 mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
Projected salts concentration in ground water near SP-11	410 mg/L	**640** µmhos/cm	projected EC of ground water at SP-11 just prior to discharge to the East Boulder River
receiving streamflow, **Q_s**	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, **C_{EBR}**	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
discharge volume of ground water and percolated water, **Q_{dS}**	262,781 ft^3/d	3.0 cfs	no credit for evaporative losses taken in volume calculations
discharge concentration of ground water to East Boulder River, **C_{dS}**	410 mg/L	640 µmhos/cm	projected EC of ground water near SP-11 just prior to discharge to the East Boulder River
Projected salts concentration in the East Boulder River at EBR-004/4A	**185** mg/L	289 µmhos/cm	projected TDS in the East Boulder River at EBR-004 or EBR-004A
East Boulder Percolation Salts Loading, closure		**Percolation of 737 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond days 1-335; percolation of 737 gpm adit water days 336-548.**	
Daily salts load to ground water from percolation days 1-335	**5,758 lbs/day**	**2,964,875 lbs/18 mos**	**Total salts load to ground water from closure (548 days)**

The salts concentrations in ground water from the percolation of 737 gpm (24 hr) treated adit water plus 83 gpm (24 hr) treated tailings water is less than the Class I beneficial use criterion of 1,000 µmhos/cm. The salts concentration in surface water from the percolation of 737 gpm (24 hr) treated adit water plus 83 gpm (24 hr) treated tailings water is less than the 250 mg/L TDS recommendation for the protection of trout eggs. The closure time frame would be 18-months to account for potential delays or equipment break-downs.

Agency-Mitigated Alternative 3B, Option 2, 737 gpm: The 737 gpm (24 hr) of treated adit water and 83 gpm (24 hr) of treated East Boulder tailings waters would be preferentially disposed at the East Boulder Mine LAD areas during an 18-month closure period. All approved LAD areas would be constructed. No water would be discharged to the mine percolation pond.

East Boulder LAD Areas 2, 3-Upper, 4, and 6 Hydraulic Loading, closure		**LAD of 737 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Areas 2, 3-Upper, 4, and 6; no percolation would be used**	
East Boulder Tailings Impoundment discharge volume	40 MG	**335** days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83** gpm (24 hr)	166 gpm (12 hr)	rate to dewater the impoundment
East Boulder Adit Flow rate	**737** gpm (24 hr)	1,474 gpm (12 hr)	Adit Flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	820 gpm (24 hr)	**1,640** gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	293 gpm (24 hr)	**1,450** gpm (12 hr)	hydraulic capacity of all East Boulder Mine LAD Areas
Summer LAD Area 6 maximum hydraulic load	56,406 ft^3/d	586 gpm (12 hr)	evaporator maximum flow rate, 10.2 ac (CES 2008)
Summer LAD Area 4 maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.2 ac (CES 2008)
Summer LAD Area 3 Upper maximum hydraulic load	26,952 ft^3/d	280 gpm (12 hr)	evaporator maximum flow rate, 11.3 ac (CES 2008)
Summer LAD Area 2 maximum hydraulic load	29,262 ft^3/d	304 gpm (12 hr)	center pivot maximum flow rate, 13.9 ac (CES 2008)
Summer total hydraulic load	18,289 ft^3/d	**190** gpm (12 hr)	**Summer** excess volume of water that must be **percolated**
Summer area available for LAD	46.6 ac	32.7 ac	Winter area available for LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465 ft^3/d	410 gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter LAD Area 4 snowmaking max hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate, 11.2 ac (CES 2008)
Winter LAD Area 3 Upper snowmaking max hydraulic load	7,701 ft^3/d	80 gpm (12 hr)	snowmaker maximum flow rate 11.3 ac (CES 2008)

Winter total hydraulic load	102,995 ft^3/d	**1,070** gpm (12 hr)	**Winter** excess volume of water that must be **percolated**	

The hydraulic load of 737 gpm adit water plus 83 gpm East Boulder tailings waters exceeds the capacity of the approved LAD areas in summer and winter and cannot be managed solely by land application at East Boulder Mine; some excess waters must be percolated.

Agency-Mitigated Alternative 3B, Option 3, 373 gpm: The 737 gpm (24 hr) of adit water and 83 gpm of tailings waters would be treated and preferentially disposed at the mine LAD areas during an 18-month closure period. All approved LAD areas would be constructed. Excess treated waters would be discharged to the East Boulder Mine percolation pond.

East Boulder Salt Loading Input Parameters, closure	**LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas during the 120 day LAD season with percolation of the excess water at the mine percolation pond for the remainder of closure**		
Summer LAD and percolation daily salts load during closure Days 1-120	5,758 lbs/day	**508** gpm (24 hr)	total summer LAD rate
Summer volume of excess water that must be percolated Days 1-120	**95** gpm (24 hr)	76 lbs/ac/day	Summer LAD salts application rate per acre per day
Winter snowmaking & percolation daily salts load during closure Days 1-120	5,758 lbs/day	**200** gpm (24 hr)	total winter snowmaking rate
Winter volume of excess water that must be percolated Days 1-120	**535** gpm (24 hr)	61 lbs/ac/day	Winter Snowmaking salts application rate per acre per day
Daily salts load during closure days 121-335	5,091 lbs/day	18,289 ft^3/d	summer volume of percolated water in cubic feet per day, days 1-120
volume of water that must be percolated Days 121-335	**725** gpm (24 hr)	139,572 ft^3/d	volume of percolated water in cubic feet per day, days 121-335
Daily salts load during closure days 336-548	4,864 lbs/day		
volume of water that must be percolated Days 336-548	**737** gpm (24 hr)	141,882 ft^3/d	volume of percolated water in cubic feet per day, days 336-548
Total combined salts loading (LAD plus percolation) during summer closure	**2,821,461** lbs/18 mos		
Total combined salts loading (Snowmaking plus percolation) during winter closure	**2,821,461** lbs/18 mos		

Ground Water Inputs Below East Boulder Mine LAD area, at Closure	**LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas during the 120 day LAD season with percolation of the excess water at the mine percolation pond for the remainder of closure**		
depth of aquifer, $\mathbf{D_2}$	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2		D * W, allowed by 17.30.517(d)
70% Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	77,005 ft^3/d	400 gpm (24 hr)	MPDES Statement of Basis, p.25-26
Volume of ground water available for mixing beneath LAD area $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
concentration of salt in mixed adit plus tailings waters in percolated waters, $\mathbf{C_P}$	585 mg/L	550 mg/L	concentration of salt in adit water
median operational TDS concentration in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	259 mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
effective concentration of salt applied during LAD (hydraulic evaporation applied; no salts treatment credit), $\mathbf{C_{LAD}}$	836 mg/L		
upgradient/background concentration of TDS in ground water (avg at WW-1), $\mathbf{C_A}$	106 mg/L		MPDES Statement of Basis, p. 24

receiving stream ambient concentration at EBR-001, C_{EBR}	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
Volume of water: **summer LAD** (hydraulic evaporation applied) **days 1-120**, V_s	68,390 ft^3/d	355 gpm (24 hr)	Volume of water applied at LAD areas 2, 3, 4, 6 (evaporation applied)
Volume of water: **summer percolation** (no evaporation or treatment credit) **days 1-120**, V_p	18,289 ft^3/d	95 gpm (24 hr)	Volume of excess water (above summer LAD capacity)
Volume of water: **winter snowmaking** (hydraulic evaporation applied) **days 1-120**, V_{W1}	26,884 ft^3/d	140 gpm (24 hr)	winter volume from LAD areas 3, 4, 6; maximum capacity (evaporation applied)
Volume of water: **winter percolation** (no evaporation or treatment credit) **days 1-120**, V_{W2}	102,995 ft^3/d	535 gpm (24 hr)	winter volume from percolation; excess water needing disposal
Volume of water that is **percolated after the LAD** season **days 121-335**	139,572 ft^3/d	725 gpm (24 hr)	adit plus tailings waters
Volume of adit water **percolated for remainder of closure period days 336-548**	141,882 ft^3/d	737 gpm (24 hr)	adit water
Summer salt concentration in ground water near SP-11, **Days 1-120**	435 mg/L	**678** µmhos/cm	days 1-120 projected concentration of salts in ground water near SP-11, summer closure
Summer salt concentration in ground water near SP-11, **Days 121-355**	417 mg/L	**651** µmhos/cm	days 121-335 projected concentration of salts in ground water near SP-11, summer closure
Summer salt concentration in in ground water near SP-11, **Days 336-548**	396 mg/L	**618** µmhos/cm	days 336-548 projected concentration of salts in ground water near SP-11, summer closure
Winter salt concentration in ground water near SP-11, **Days 1-120**	418 mg/L	**652** µmhos/cm	days 1-120 projected concentration of salts in ground water near SP-11, winter closure
Winter salt concentration in ground water near SP-11, **Days 121-335**	415 mg/L	**648** µmhos/cm	days 121-335 projected concentration of salts in ground water near SP-11, winter closure
Winter salt concentration in in ground water near SP-11, **Days 336-548**	396 mg/L	**618** µmhos/cm	days 336-548 projected concentration of salts in ground water near SP-11, winter closure

The EC of ground water during summer and winter closure scenarios meets 1,000 µmhos/cm Class I Beneficial use from the LAD and percolation of 737 gpm (24 hr) treated adit water and 83 gpm (24 hr) treated tailings waters.

East Boulder River Concentration below LAD area — **LAD of maximum volume of treated adit plus tailings waters at the East Boulder Mine LAD Areas during the 120 day LAD season with percolation of the excess water at the mine percolation pond for the remainder of closure; the highest projected concentration (summer closure days 1-120) was used for this calculation**

receiving streamflow, Q_s	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, C_{EBR}	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
summer discharge volume of ground water at **highest projected salts** concentration, Q_{ds}	191,575 ft^3/d	2.2 cfs	hydraulic evaporative losses taken; highest summer salt concentration days 1-120
winter discharge volume of ground water at **highest projected salts** concentration, Q_{ds}	234,775 ft^3/d	2.7 cfs	hydraulic evaporative losses taken; highest winter salt concentration days 1-121
highest summer projected discharge **concentration** of salts to East Boulder River, C_{ds}	435 mg/L	678 µmhos/cm	highest projected EC of ground water during summer closure days 1-120
highest winter projected discharge **concentration** of salts to East Boulder River, C_{dW}	418 mg/L	652 µmhos/cm	highest projected EC of ground water during winter closure days 1-121

lowest projected East Boulder River salts concentration	**175**	**mg/L**	273 μmhos/cm	summer and winter lowest projected EC of surface water days 336-548
highest summer projected East Boulder River salts concentration	**167**	**mg/L**	261 μmhos/cm	highest projected EC of surface water during summer closure days 1-120
highest winter projected East Boulder River salts concentration	**179**	**mg/L**	279 μmhos/cm	highest projected EC of surface water during winter closure days 1-121

The TDS concentration in the East Boulder River is less than the 250 mg/L recommendation protective of trout eggs.

Agency-Mitigated Alternative 3B, Option 1, 150 gpm: This option evaluates the feasibility of the East Boulder Mine WMP Proposed Action Alternative 2B 12-month closure period. This option would percolate the entire treated 150 gpm of adit water with the maximum volume of treated East Boulder tailings waters that would meet the 30 lbs/day MPDES permit nitrogen limit. The 150 gpm adit and 83 gpm tailings waters would be treated in the BTS/Anox system and be preferentially disposed in the mine percolation pond during the closure period. No water would be land applied at closure.

		550 mg/L	median **adit TDS concentration** SMC monitoring data
		897 mg/L	median **tailings waters TDS concentration** SMC monitoring data
		150 gpm (24 hr)	adit flow rate at closure
		83 gpm (24 hr)	**tailings flow rate at closure**
	1,051 μmhos/cm	674 mg/L	weighted average concentration of TDS (adit plus tailings waters)

East Boulder Hydraulic Loading Calculations, Percolation Pond			**Percolation of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond.**	
East Boulder Tailings Impoundment discharge volume	40	MG	**335 days**	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83**	gpm (24 hr)	166 gpm (12 hr)	rate to dewater the impoundment
volume of water from East Boulder Tailings impoundment per day	15,979	ft^3/d	28,877 ft^3/d	volume of adit water per day
East Boulder Adit Flow rate	**150**	gpm (24 hr)	300 gpm (12 hr)	adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233**	gpm (24 hr)	466 gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Volume of adit plus tailings waters to be percolated in cubic feet per day	44,856	ft^3/d	2,210 gpm (12 hr)	capacity of East Boulder Mine percolation pond MPDES Statement of Basis p. 4

The volume of treated adit plus tailings waters needing disposal is within the hydraulic capacity of the percolation pond.

East Boulder MPDES permit source-specific (percolation pond) mixing zone calculations			**Percolation of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond.**	
depth of aquifer, **D**	80	ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385	ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, L_1	3,600	ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3			MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	77,005	ft^3/d	400 gpm (24 hr)	MPDES Statement of Basis, p. 25-26
upgradient/background concentration of TDS in ground water (avg at WW-1), C_A	106	mg/L	165 μmhos/cm	SMC Monitoring Data
angle of dispersion	0.087421693	tan 5°		allowed by 17.30.517(d)
width of mixing zone, W_1	700	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)

area of mixing zone, $\mathbf{A_1}$	55,977 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_1}$=kiA	77,005 ft^3/d	400 gpm	MPDES Statement of Basis, p.25-26
upgradient/background concentration of TDS in ground water (avg at WW-1), $\mathbf{C_A}$	106 mg/L		MPDES Statement of Basis, p. 24
Volume of ground water available for mixing beneath LAD area $\mathbf{Q_2}$=kiA	27,914 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
median operational TDS concentration in ground water below percolation pond at EBMW-6, $\mathbf{C_2}$	259 mg/L	404 μmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
projected salts concentration in ground water near SP-11, **Days 1-335**	305 mg/L	**475** μmhos/cm	projected EC of ground water at SP-11 just prior to discharge to the East Boulder River
projected salts concentration in ground water near SP-11, **Days 336-548**	234 mg/L	**365** μmhos/cm	
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_{EBR}}$	49 mg/L	76 μmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
discharge volume of ground water and percolated water days 1-335, $\mathbf{Q_{ds}}$	149,775 ft^3/d	1.7 cfs	no credit for evaporative losses taken in volume calculations, adit plus tailings
discharge volume of ground water and percolated water days 336-548, $\mathbf{Q_{ds}}$	133,797 ft^3/d	1.5 cfs	no credit for evaporative losses taken in volume calculations, adit water
discharge concentration of ground water to East Boulder River days 1-335, $\mathbf{C_{ds}}$	305 mg/L	475 μmhos/cm	projected EC of ground water near SP-11 just prior to discharge to the East Boulder River
discharge concentration of ground water to East Boulder River days 336-548, $\mathbf{C_{ds}}$	234 mg/L	365 μmhos/cm	
Projected salts concentration in the East Boulder River at EBR-004/4A **days 1-335**	**115** mg/L	179 μmhos/cm	projected TDS in the East Boulder River at EBR-004 or EBR-004A, days 1-335
Projected salts concentration in the East Boulder River at EBR-004/4A **days 336-548**	**92** mg/L	144 μmhos/cm	projected TDS in the East Boulder River at EBR-004 or EBR-004A, days 336-548
East Boulder Percolation Salts Loading, closure		**Percolation of 737 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder percolation pond.**	
Daily salts load to ground water from percolation, days 1-335	**1,883** lbs/day		
Daily salts load to ground water from percolation, days 336-548	**990** lbs/day	**841,813 lbs/18 mos**	**Total salts load to ground water from closure (548 days)**

The salts concentrations in ground water from the percolation of 150 gpm (24 hr) treated adit water plus 83 gpm (24 hr) treated tailings water is less than the Class I beneficial use criterion of 1,000 μmhos/cm. The salts concentration in surface water from the percolation of 150 gpm (24 hr) treated adit water plus 83 gpm (24 hr) treated tailings water is less than the 250 mg/L TDS recommendation for the protection of trout eggs. The closure time frame would be 18-months to account for potential delays or equipment break-downs.

Agency-Mitigated Alternative 3B, Option 2, 150 gpm: The 150 gpm (24 hr) of adit water would be treated with 83 gpm (24 hr) of East Boulder tailings waters and be preferentially disposed at the East Boulder Mine LAD Area 6 during the closure period. No other LAD areas would be built. No percolation would be used.

East Boulder LAD Area 6 Hydraulic Loading, closure		**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; no percolation would be used**	
East Boulder Tailings Impoundment discharge volume	40 MG	**335** days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83** gpm (24 hr)	166 gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150** gpm (24 hr)	300 gpm (12 hr)	East Boulder adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233** gpm (24 hr)	**466** gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	293 gpm (24 hr)	**586** gpm (12 hr)	hydraulic capacity of East Boulder Mine LAD Area 6
Summer hydraulic load that must be **percolated**	**0** ft^3/d	**0** gpm (12 hr)	**Summer** excess volume of water that must be **percolated**
Summer area available for LAD	46.6 ac	32.7 ac	Winter area available for LAD

Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465 ft^3/d	410 gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter hydraulic load of water that must be **percolated**	5,390 ft^3/d	**56** gpm (12 hr)	**Winter** excess volume of water that must be **percolated**

The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters can be managed at LAD Area 6 during closure that commences in summer. The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters cannot be managed solely at LAD Area 6 during closure that commences in winter; percolation must be used to dispose of 56 gpm (24 hr).

Agency-Mitigated Alternative 3B, Option 3, 150 gpm: The 150 gpm (24 hr) of adit water would be treated with 83 gpm (24 hr) of East Boulder tailings waters and be preferentially disposed at the East Boulder Mine LAD Area 6 during the closure period, with excess waters percolated at the mine pond. No other LAD areas would be built.

East Boulder LAD Area 6 Hydraulic Loading, closure		**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated**	
East Boulder Tailings Impoundment discharge volume	40 MG	**335** days	time to dewater the tailings impoundment
rate to dewater East Boulder tailings impoundment	**83** gpm (24 hr)	166 gpm (12 hr)	rate to dewater the impoundment
East Boulder adit flow rate	**150** gpm (24 hr)	300 gpm (12 hr)	East Boulder adit flow rate
total combined hydraulic load (adit plus East Boulder tailings waters)	**233** gpm (24 hr)	**466** gpm (12 hr)	total combined flow (adit plus East Boulder tailings waters)
Summer hydraulic capacity of East Boulder Mine LAD Area 6	293 gpm (24 hr)	**586** gpm (12 hr)	hydraulic capacity of East Boulder Mine LAD Area 6
Summer hydraulic load that must be **percolated**	**0** ft^3/d	0 gpm (12 hr)	**Summer** excess volume of water that must be **percolated**
Summer area available for LAD	46.6 ac	32.7 ac	Winter area available for LAD
Winter hydraulic capacity of East Boulder Mine LAD Area 6	39,465 ft^3/d	410 gpm (12 hr)	snowmaker maximum flow rate, 10.2 ac (CES 2008)
Winter hydraulic load of water that must be **percolated**	5,390 ft^3/d	**56** gpm (12 hr)	**Winter** excess volume of water that must be **percolated**

The hydraulic load of 150 gpm (24 hr) adit water plus 83 gpm (24 hr) tailings waters can be managed using LAD Area 6 and the percolation pond during closure.

East Boulder LAD Area 6 salts loading, closure		**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated**	
Summer salts load to soil and ground water disposed at **LAD Area 6,** days 1-120	1,883 lbs/day	1,657 lbs/day	**Winter** salts load to soil and ground water disposed at **LAD Area 6,** days 1-120
Summer salts load to soil and ground water disposed at **LAD Area 6,** per acre	40 lbs/ac	51 lbs/ac	**Winter** salts load to soil and ground water disposed at **LAD Area 6,** per acre
Summer salts load **percolated** days 1-120	0 lbs/day	226 lbs/day	**Winter** salts load **percolated** days 1-120
Summer total salts load, days 1-120	**1,883** lbs/day	**1,883** lbs/day	**Winter total** salts load, days 1-120
salts load percolated, days 121-335	**1,883** lbs/day	**990** lbs/day	salts load **percolated**, days 336-548
Total Summer closure salts load to ground water, days 1-548	**841,813** lbs/18 mos	**841,813** lbs/18 mos	**Winter closure** salts load to ground water, days 1-548

Ground Water Inputs Below East Boulder Mine LAD area, at Closure		**LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated**
depth of aquifer, $\mathbf{D_2}$	15 ft	allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d	MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft	MPDES Statement of Basis, p. 25-26
width of source	700 ft	MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900 ft	MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°	allowed by 17.30.517(d)

width of zone, W_2	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_2	14,303 ft^2		D * W, allowed by 17.30.517(d)
70% Volume of ground water available for mixing Q_1=kiA	77,005 ft^3/d	400 gpm (24 hr)	MPDES Statement of Basis, p.25-26
Volume of ground water available for mixing beneath LAD area Q_2=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
concentration of salt in mixed adit plus tailings waters (percolated waters), C_P	674 mg/L	**1,051** µmhos/cm	calculated above
median operational TDS concentration in ground water below percolation pond at EBMW-6, C_2	259 mg/L	404 µmhos/cm	calculated value of EC at EBMW-6 at closure based on SMC Monitoring Data from 2000-2007 (pre 2007 spill)
effective salt concentration applied at LAD (evaporation applied; no treatment credit), C_{LAD}	**962** mg/L	**1,501** µmhos/cm	concentrated due to hydraulic evaporative loss
upgradient concentration of TDS in ground water (at WW-1), C_A	106 mg/L	165 µmhos/cm	MPDES Statement of Basis, p. 24
receiving stream ambient concentration at EBR-001, C_{EBR}	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC calculated from SMC monitoring data (Hydrometrics 2001)
Volume of water: **summer LAD** (hydraulic evaporation applied) days 1-120, V_s	39,484 ft^3/d	410 gpm (12 hr)	Volume of water disposed in summer at LAD Area 6, evaporation credit taken
Volume of water: **summer percolation** (no evaporation or treatment credit) days 1-120, V_p	0 ft^3/d	0 gpm (12 hr)	summer percolation; no evaporation or treatment credit
Volume of water: **winter snowmaking** (hydraulic evaporation applied) days 1-120, V_{W1}	27,626 ft^3/d	287 gpm (12 hr)	Volume of water disposed in winter at LAD Area 6, evaporation credit taken
Volume of water: **winter percolation** (no evaporation or treatment credit) days 1-120, V_{W2}	5,390 ft^3/d	56 gpm (12 hr)	winter percolation; no evaporation or treatment credit
Volume of water that is **percolated after the LAD** season days 121-335	22,428 ft^3/d	**233** gpm (24 hr)	
Volume of adit water **percolated for remainder of closur**e period days 336-548	14,439 ft^3/d	150 gpm (24 hr)	
Summer salt concentration in ground water near SP-11, **Days 1-120**	370 mg/L	**577** µmhos/cm	days 1-120 projected concentration of salts in ground water near SP-11, summer closure
Summer salt concentration in ground water near SP-11, **Days 121-355**	264 mg/L	**411** µmhos/cm	days 121-335 projected concentration of salts in ground water near SP-11, summer closure
Summer salt concentration in in ground water near SP-11, **Days 336-548**	197 mg/L	**307** µmhos/cm	days 336-548 projected concentration of salts in ground water near SP-11, summer closure
Winter salt concentration in ground water near SP-11, **Days 1-120**	331 mg/L	**516** µmhos/cm	days 1-120 projected concentration of salts in ground water near SP-11, winter closure
Winter salt concentration in ground water near SP-11, **Days 121-335**	255 mg/L	**398** µmhos/cm	days 121-335 projected concentration of salts in ground water near SP-11, winter closure
Winter salt concentration in in ground water near SP-11, **Days 336-548**	195 mg/L	**304** µmhos/cm	days 336-548 projected concentration of salts in ground water near SP-11, winter closure

Disposal of 150 gpm adit and 83 gpm tailings waters using land application at LAD Area 6 and percolation of excess waters meets the Class I beneficial use criterion of 1,000 µmhos/cm.

East Boulder River Concentration below LAD area		LAD of 150 gpm treated adit water with 83 gpm treated tailings waters at the East Boulder LAD Area 6; the excess volume of water would be percolated; calculations were only made for the highest projected ground water EC	
receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis p. 4
receiving stream ambient concentration, $\mathbf{C_{EBR}}$	49 mg/L	76 μmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
discharge volume of ground water at **lowest summer** salts concentration days **336-548**, $\mathbf{Q_{dSL}}$	119,334 ft^3/d	1.4	cfs; corresponds to lowest projected ground water TDS concentration, summer closure
discharge volume of ground water at **highest summer** salts concentration days **1-120**, $\mathbf{Q_{dSH}}$	144,380 ft^3/d	1.7	cfs; corresponds to highest projected ground water TDS concentration, summer closure
discharge volume of ground water at **lowest winter** salts concentration days **336-548**, $\mathbf{Q_{dWL}}$	119,334 ft^3/d	1.4	cfs; corresponds to lowest projected ground water TDS concentration, winter closure
discharge volume of ground water at **highest winter** salts concentration days **1-120**, $\mathbf{Q_{dWH}}$	137,912 ft^3/d	1.6	cfs; corresponds to highest projected ground water TDS concentration, winter closure
lowest summer projected discharge concentration of salts to East Boulder River, $\mathbf{C_{dSL}}$	197 mg/L		days 336-548 projected concentration of salts in ground water near SP-11, summer closure
highest summer projected discharge concentration of salts to East Boulder River, $\mathbf{C_{dSH}}$	370 mg/L		days 1-120 projected concentration of salts in ground water near SP-11, summer closure
lowest winter projected discharge concentration of salts to East Boulder River, $\mathbf{C_{dWL}}$	195 mg/L		days 336-548 projected concentration of salts in ground water near SP-11, winter closure
highest winter projected discharge concentration of salts to East Boulder River, $\mathbf{C_{dWH}}$	331 mg/L		days 1-120 projected concentration of salts in ground water near SP-11, winter closure
lowest summer projected concentration of salts in the East Boulder River	**81 mg/L**	126 μmhos/cm	lowest projected EC of surface water near EBR-004/4A during summer closure days 336-548
highest summer projected concentration of salts in the East Boulder River	**129 mg/L**	201 μmhos/cm	highest projected EC of surface water near EBR-004/4A during summer closure days 1-120
lowest winter projected concentration of salts in the East Boulder River	**80 mg/L**	125 μmhos/cm	lowest projected EC of surface water near EBR-004/4A during winter closure days 336-548
highest winter projected concentration of salts in the East Boulder River	**117 mg/L**	182 μmhos/cm	highest projected EC of surface water near EBR-004/4A during witer closure days 1-120

The highest projected TDS concentration in the East Boulder River is less than the 250 mg/L recommendation for the protection of trout eggs.

Spreadsheet 2C Nitrogen: Proposed Action Alternative 2C Boe Ranch LAD System Operations and Closure Nitrogen Analyses

Per KP 2000c, if the Boe Ranch LAD system was constructed it would be the preferred disposal option for treated adit water during operations and for treated adit plus tailings waters during the first year of closure. The East Boulder Mine percolation pond would be used for contingency disposal of treated adit water during operations. Monitoring well RMW-3 is located at Boe Ranch downgradient of the proposed LAD area and is considered to represent ambient total inorganic nitrogen (TIN) values. Baseline concentrations of TIN in the East Boulder River average 0.1 mg/L. At closure, all adit and East Boulder tailings waters would be treated through the BTS/Anox system then routed to the Boe Ranch LAD storage pond all year and disposed through LAD pivots during the summer LAD season. For the Boe Ranch LAD, calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Boe Ranch LAD area any water that percolates below the root zone is assumed to immediately enter the aquifer. It is assumed that the Boe Ranch LAD area would not

have an MPDES permit.The BTS/Anox system would be the same as in Alternative 2B, with treated water routed to Boe Ranch LAD during operations and 12 months of closure. For this analysis 20% of the applied TIN concentrations are expected to flush through the soil column/unsaturated zone to ground water at some point during the year. Ground water beneath the LAD area and LAD storage pond flows downgradient where it is recharged by the Mason Ditch, then discharges to the East Boulder River. These calculations assume that during operations treated adit waters are routed to the Boe Ranch LAD storage pond. During summer LAD, PoleCat evaporators accomplish 30% evaporation and the center pivots accomplish 30% evaporation. In the winter, PoleCat snowmaking accomplishes 30% evaporation up slope of the lined LAD storage pond. At closure, treated adit and tailings waters would be routed to the Boe Ranch LAD storage pond which would hold 100 million gallons (MG) of adit water, and mixing of these waters occurs prior to

disposal at the LAD pivots. A weighted average was used to determine the concentration of TIN in the mixed LAD storage pond water The East Boulder Mine MPDES Permit has an annual average TIN limit of 30 lbs/day. Historical maximum TIN load after BTS/Anox treatment of 20 pounds per day was used in this analysis. These calculations assume that there will be a leak in the Boe Ranch LAD storage pond, and the liner leakage, land-applied water, and Mason Ditch waters contribute to ground water quality prior to discharge into the East Boulder River. It is assumed that all 10 proposed Boe Ranch LAD center pivots on 194 acres in Section 17 will be developed for use during operations and closure, and application of water is at agronomic rates. The TIN concentration of the treated discharge will vary with total flow rate.

OPERATIONS CALCULATIONS

The Alternative 2C Nitrogen OPERATIONS Option 1, 737 gpm: Preferential disposal of all 737 gpm adit water would occur at the Boe Ranch LAD at agronomic rates with contingency disposal of treated adit water at the East Boulder Mine percolation pond.

For all calculations in this spreadsheet, assume the BTS/Anox capacity is 1,000 gpm for 24 hours

and the Boe Ranch LAD design capacity is 1,486 gpm for 12 hr rate (743 gpm for 24 hr rate)

OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations		**Assume the Boe Ranch LAD storage pond is full on the first day of the LAD season**	
assumed volume in Boe Ranch LAD storage pond	100 MG		
area available for LAD in section 17, all pivots included	194 ac	95 days	time to fill the Boe Ranch LAD storage pond at 737 gpm after the LAD season
agronomic application rate (SMC 2000 Apdx K)	**7.7** gpm/ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates for 120 days on 194 acres, all pivots in Section 17
adit flow rate at closure	**737** gpm (24 hr)	1,474 gpm (12 hr)	adit flow rate at closure

OPERATIONS During the 120 day LAD season, the hydraulic load of 737 gpm adit water can be managed at Boe Ranch LAD area if all 10 pivots are operatotal inorganic nitrogeng at agronomic rates as proposed by SMC (KP 2000c). However, the LAD storage pond would fill the first 95 days of winter and excess adit waters would have to be managed at the East Boulder Mine and by winter snowmaking. During the following LAD season, the hydraulic load of 737 gpm adit water could be managed at Boe Ranch LAD area at agronomic rates, but the LAD storage pond could not be dewatered at the Boe Ranch LAD area. Essentially, the adit water would be managed as in Alternatives 1B and 2B at the East Boulder Mine with similar impacts.

The Alternative 2C Nitrogen OPERATIONS Option 2, 737 gpm: During the LAD season days 1-120, up to 164 gpm (24 hr) treated adit water plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates, and 573 gpm (24 hr) is disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 283 gpm (24 hr) treated adit water can be routed to the Boe Ranch LAD storage pond and up to 454 gpm (24 hr) would be disposed at the East Boulder Mine percolation pond.

OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations		**Assume Boe Ranch LAD storage pond is full on the first day of the LAD season. During the LAD season days 1-120, up to 164 gpm (24 hr rate) treated adit water plus 579 gpm (24 hr rate) stored pond water is applied at Boe Ranch LAD at agronomic rates**	
assumed volume in Boe Ranch LAD storage pond	100 MG	120 days	time to dewater Boe Ranch LAD storage pond in one season
area available for LAD in section 17, all pivots included	194 ac	579 gpm (24 hr)	rate to dewater Boe Ranch LAD storage pond in one season
agronomic application rate (SMC 2000 Apdx K) 12 hr/day	**7.7** gpm/ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates for 120 days on 194 acres, all Section 17 pivots

adit flow rate at closure	**737**	gpm (24 hr)	329	gpm (12 hr)	capacity available to land apply adit water at Boe Ranch LAD areas
rate treated adit water must be **percolated** at East Boulder Mine so Boe Ranch LAD storage pond can be dewatered during LAD season **(days 1-120)**	**573**	gpm (24 hr)	**164**	gpm (24 hr)	adit flow rate land applied at Boe Ranch to meet available capacity using Hertzler Ranch LAD average application rate
rate treated adit water is pumped from East Boulder Mine to **fill Boe Ranch LAD storage pond** for the remainder of the year **(days 121-365)**	**283**	gpm (24 hr)	**454**	gpm (24 hr)	rate that treated adit water is **percolated** at East Boulder Mine percolation pond for the remainder of the year **(days 121-365)**

OPERATIONS To operationally address the hydraulic volume of adit water and to annually dewater the Boe Ranch LAD storage pond during the LAD season, 164 gpm treated adit water can be land applied at Boe Ranch using agronomic rates, and the remaining 454 gpm must be disposed at the East Boulder Mine percolation pond. During the rest of the year, 283 gpm treated adit water would be routed to the Boe Ranch LAD storage pond, and 454 gpm treated adit water would be percolated at the East Boulder Mine percolation pond.

OPERATIONS *East Boulder Mine* total inorganic nitrogen Load Calculations

Percolation of treated adit waters at East Boulder Mine; Days 1-120, 573 gpm water in excess of the LAD capability at the Boe Ranch LAD; Days 121-365, 454 gpm water percolated in excess of water routed to the Boe Ranch LAD storage pond

OPERATIONS total inorganic nitrogen load at East Boulder Mine from **percolation during LAD season days 1-120**	**573**	gpm (24 hr)	**15.5**	lbs/day	treated adit waters load days 1-120
OPERATIONS total inorganic nitrogen load at East Boulder Mine from **percolation the rest of the year days 121-365**	**454**	gpm (24 hr)	**12.3**	lbs/day	treated adit waters load days 121-365

OPERATIONS The total inorganic nitrogen load from percolation of 454 to 573 gpm treated adit water at the East Boulder Mine percolation pond during operations would be 12.3 to 15.5 lbs/day which is less than the MPDES Permit total inorganic nitrogen 30 lbs/day load limit.

OPERATIONS *Boe Ranch LAD* Ground Water total inorganic nitrogen Calculations Days 1-120

			737	gpm (24 hr)	adit flow rate at closure (24 hr rate)
			20	lbs/day	historical maximum post BTS/Anox total inorganic nitrogen load
			2.3	mg/L	treated concentration of adit waters based on historical max concentration
length of LAD season	120	days	**1,486**	gpm (12 hr)	hydraulic load that can be land applied at agronomic rates for 120 days on 194 acres
depth of aquifer, **D**	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283	ft/d			mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10	ft			assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone LAD storage pond liner leakage, W_1	229	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_1	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_1	3,428	ft^2			D * W, allowed by 17.30.517(d)
Q_1=kiA, ground water available for mixing at liner leakage	97	ft^3/d			allowed by 17.30.517(d)
concentration of total inorganic nitrogen in ambient ground water; median value from RMW-3a, C_A	0.1	mg/L			median ambient total inorganic nitrogen concentration in ground water derived from SMC monitoring data
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, L_2	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application mixing zone, W_2	3,593	ft			allowed by 17.30.517(d)
cross sectional area of aquifer at LAD application, A_2	53,901	ft^2			D * W, allowed by 17.30.517(d)
Q_2=kiA, ground water available for mixing at LAD application	1,525	ft^3/d			allowed by 17.30.517(d)

volume of applied LAD end of pipe, no evaporation taken, **V_2**	143,041 ft^3/d	**164** gpm (24 hr)	adit water applied; no evaporation credit taken
Concentration of total inorganic nitrogen in applied LAD waters (adit water); assume pivots 30% evaporation, 80% post plant uptake, **C_2**	0.6 mg/L		treated adit water concentration with nitrogen removal credit given for evaporation and plant uptake; the amount of nitrogen that is expected to percolate to ground water
volume of Boe Ranch LAD storage pond liner leakage, **V_1**	27 ft3/d		KP 2000c Apdx K, Tables
calculated total inorganic nitrogen in LAD storage pond liner leakage discharge (adit water), **C_1**	2.3	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, **L_3**	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, **W_3**	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, **A_3**	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		allowed by 17.30.517(d)
25% of the total volume of Mason Ditch that is assumed to infiltrate, **V_3**	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assume the total inorganic nitrogen in Mason Ditch is equivalent to the median concentration at EBR-007, **C_3**	0.1 mg/L		SMC monitoring data
OPERATIONS Ground water calculations downgradient of Boe Ranch LAD days 1-120			**During the LAD season, up to 164 gpm (24 hr) plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates.**
total inorganic nitrogen concentration in ground water below Boe Ranch LAD storage pond from liner leakage	0.5 mg/L		projected total inorganic nitrogen concentration in ground water downgradient of the Boe Ranch LAD area
total inorganic nitrogen concentration in ground water down gradient of Boe Ranch LAD area from liner leakage and applied LAD	0.6 mg/L		30% hydraulic evaporation credit applied; projected total inorganic nitrogen concentration in ground water from assumed Boe Ranch LAD storage pond leakage and LAD area
total inorganic nitrogen concentration in ground water below Mason Ditch from liner leakage, applied LAD, and Mason Ditch seepage	0.5 mg/L		projected total inorganic nitrogen concentration in ground water below the Mason Ditch
OPERATIONS total inorganic nitrogen concentration in **ground water downgradient of Mason Ditch, C_d**	**0.5** mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
OPERATIONS The concentration of total inorganic nitrogen in ground water at Boe Ranch from the LAD of 1,486 gpm (12 hr) would be less than the DEQ-7 ground water standard of 10 mg/L.			
OPERATIONS East Boulder River calculations downgradient of Boe Ranch LAD			**During the LAD season, up to 164 gpm (24 hr) plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates.**
receiving streamflow irrigation season, **Q_s**	172,800 ft^3/d	2.0 cfs	7Q10 value at EBR-008 for East Boulder Mine streamflow after irrigation withdrawals below Boe Ranch LAD (CES 2008)
receiving streamflow non-irrigation season, **Q_s**	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow assumed at EBR-008, non-irrigation season
receiving stream ambient concentration at EBR-007, **C_s**	0.1 mg/L		SMC monitoring data
ground water discharge volume, **Q_d**	146,652 ft^3/d	1.7 cfs	volume of ground water discharge to the East Boulder River in cubic feet per second
ground water concentration downgradient of Mason Ditch, **C_d**	0.5 mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River

OPERATIONS East Boulder River total inorganic nitrogen concentration, downgradient of Boe Ranch LAD **during the irrigation season (2.0 cfs)**	**0.3** mg/L		projected total inorganic nitrogen concentration in the East Boulder River at EBR-008 during irrigation season
OPERATIONS East Boulder River total inorganic nitrogen concentration, downgradient of Boe Ranch LAD **non-irrigation season (>5.0 cfs)**	**0.2** mg/L		projected total inorganic nitrogen concentration in the East Boulder River at EBR-008 during non-irrigation season

OPERATIONS The total inorganic nitrogen concentration in the East Boulder River below Boe Ranch from the application of 1,486 gpm (12 hr) LAD waters would be less than 1.0 mg/L.

The Alternative 2C Nitrogen OPERATIONS Option 1, 150 gpm: During the LAD season days 1-120, up to 150 gpm (24 hr) treated adit water plus 301 gpm (24 hr) stored pond water would be applied at Boe Ranch LAD at agronomic rates. No water would be disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 150 gpm (24 hr) treated adit water would be routed to the Boe Ranch LAD storage pond. The capacity of the Boe Ranch LAD storage pond would be adequate to store eight months of treated adit water (52 MG).

Boe Ranch LAD storage pond capacity is sufficient for 8 months storage of adit water at 150 gpm

OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations

		120 days	length of LAD season at Boe Ranch
		108 MG	capacity of Boe Ranch LAD storage pond
volume in LAD storage pond, assume 8 months winter storage of adit water	52 MG	602 gpm (12 hr)	rate to dewater Boe Ranch LAD storage pond in one season
area available for LAD in section 17, all pivots included	194 ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied using agronomic rates for 120 days on 194 acres, all pivots in Section 17
agronomic application rate (KP Apdx K 2000) 12 hr/day	**7.7** gpm/ac	**902** gpm (12 hr)	hydraulic load to be applied at Boe Ranch during the 120 day LAD season to dewater the pond and dispose of all treated adit water
adit flow rate	**150** gpm (24 hr)	500 days	time to fill the Boe Ranch LAD storage pond at 150 gpm after the LAD season

OPERATIONS During the 120 day LAD season, the hydraulic load of 150 gpm (24 hr) adit water plus 602 gpm (12 hr) rate of dewatering 8 months stored water in the LAD storage pond (52 MG) can be managed at Boe Ranch LAD area if all 10 pivots are operating at the proposed agronomic rates.

OPERATIONS *Boe Ranch LAD* total inorganic nitrogen Calculations days 1-120

Assume Boe Ranch LAD storage pond contains 52 MG treated adit water on the first day of the LAD season; disposal of 150 gpm treated adit water plus 602 gpm (12 hr) stored waters at Boe Ranch LAD

		150 gpm (24 hr)	adit flow rate at closure (24 hr rate)
historical maximum post BTS/Anox total inorganic nitrogen load	**20** lbs/day	11.1 mg/L	treated concentration of adit waters based on historical maximum concentration
depth of aquifer, **D**	15 ft	**902** gpm (12 hr)	hydraulic load actually applied at Boe Ranch during the 120 day LAD season to dewater the pond and dispose of all treated adit water
hydraulic conductivity, **k**	0.283 ft/d		allowed by 17.30.517(d)
gradient, **i**	0.1		mid-range estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		estimate, used by Hydrometrics (KP 2000c)
width of mixing zone LAD storage pond liner leakage, $\mathbf{W_1}$	229 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
angle of dispersion	0.087421693 tan 5°		width of source + (tan 5 * length) allowed by 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_1}$	2,500 feet		allowed by 17.30.517(d)
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_1}$	3,428 ft^2		KP 2000c Apdx K, Tables
$\mathbf{Q_1}$=kiA, ground water available for mixing at liner leakage	97 ft^3/d		D * W, allowed by 17.30.517(d)
concentration of total inorganic nitrogen in ambient ground water; median value from RMW-3a, $\mathbf{C_A}$	0.6 mg/L		allowed by 17.30.517(d)
width of LAD application	3,200 ft		median adit total inorganic nitrogen concentration derrived from SMC monitoring data

length of LAD application, $\mathbf{L_2}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application mixing zone, $\mathbf{W_2}$	3,593 ft		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD application, $\mathbf{A_2}$	53,901 ft^2		allowed by 17.30.517(d)
$\mathbf{Q_2}$=kiA, ground water available for mixing at LAD application	1,525 ft^3/d		D * W, allowed by 17.30.517(d)
volume of applied LAD; evaporation credit taken, $\mathbf{V_2}$	121,533 ft^3/d	**902** gpm (12 hr)	hydraulic load of treated adit plus Boe Ranch LAD storage pond water
Concentration of total inorganic nitrogen in applied LAD waters (adit water); assume pivots 30% evaporation, 80% post plant uptake, $\mathbf{C_2}$	3.2 mg/L	631 gpm (12 hr)	hydraulic load of treated adit plus Boe Ranch LAD storage pond water; evaporation credit taken
volume of LAD storage pond liner leakage, $\mathbf{V_1}$	27 ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
calculated total inorganic nitrogen in LAD storage pond liner leakage discharge (adit water), $\mathbf{C_1}$	11.1 mg/L		
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		KP 2000c Apdx K, Tables
cross sectional area of aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		width of source + (tan 5 * length) allowed by 17.30.517(d)
$\mathbf{Q_3}$=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		D * W, allowed by 17.30.517(d)
25% of total volume of flow in Mason Ditch assumed to infiltrate to ground water, $\mathbf{V_3}$	43,200 ft^3/d		KP 2000c Apdx K, Tables
assume total inorganic nitrogen in Mason Ditch equivalent to median concentration at EBR-007, $\mathbf{C_3}$	0.1 mg/L	224 gpm (24 hr)	KP 2000c Apdx K, Tables
total inorganic nitrogen concentration in ground water from Boe Ranch LAD storage pond liner leakage	2.9 mg/L		no evaporation credit taken for liner leakage; projected total inorganic nitrogen concentration in ground water
total inorganic nitrogen concentration in ground water beneath Boe Ranch LAD area from liner leakage and applied LAD	2.5 mg/L		30% hydraulic evaporation credit applied; projected concentration in ground water
total inorganic nitrogen concentration in ground water at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	1.7 mg/L		30% hydraulic evaporation credit applied; projected concentration in ground water
OPERATIONS total inorganic nitrogen concentration in **ground water below Mason Ditch, $\mathbf{C_d}$**	**1.7** mg/L		projected total inorganic nitrogen concentration in ground water prior to discharge to East Boulder River

OPERATIONS The concentration of total inorganic nitrogen in ground water at Boe Ranch from the LAD of 902 gpm (12 hr) would be less than the DEQ-7 ground water standard of 10 mg/L.

OPERATIONS *Boe Ranch LAD* total inorganic nitrogen Concentrations in the East Boulder River		**Assume Boe Ranch LAD storage pond contains 52 MG treated adit water on the first day of the LAD sea disposal of 150 gpm treated adit water plus 602 gpm (12 hr) stored waters at Boe Ranch LAD**	
receiving streamflow during non-irrigation season, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow
receiving streamflow during irrigation season, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow during irrigation season (CES 2008)
receiving stream ambient concentration, $\mathbf{C_s}$	0.1 mg/L		KP 2000 Appx K
ground water discharge volume, $\mathbf{Q_d}$	168,056 ft^3/d	2.0 cfs	ground water discharge volume in cubic feet per second
ground water concentration below Mason Ditch, $\mathbf{C_d}$	1.7 mg/L		projected total inorganic nitrogen concentration in ground water prior to discharge to East Boulder River
OPERATIONS East Boulder River total inorganic nitrogen concentration downgradient of the Boe Ranch LAD **during the irrigation season (2.0 cfs)**	**0.9** mg/L		projected total inorganic nitrogen concentration in the East Boulder River during irrigation season
OPERATIONS East Boulder River total inorganic nitrogen concentration downgradient of the Boe Ranch LAD **during non-irrigation season (5.0 cfs)**	**0.5** mg/L		projected total inorganic nitrogen concentration in the East Boulder River during non-irrigation season

OPERATIONS The total inorganic nitrogen concentration in the East Boulder River below the Boe Ranch LAD from disposal of 902 gpm (12 hr) would be less than 1.0 mg/L.

CLOSURE CALCULATIONS

The Alternative 2C Nitrogen CLOSURE Option 1, 737 gpm: The East Boulder tailings impoundment would be dewatered and tailings waters treated at 260 gpm (24 hr) with 737 gpm (24 hr) adit water through the BTS/Anox. Based on the Operations hydraulic load calculations, only 743 gpm (24 hr) can be disposed at Boe Ranch LAD. During the LAD season days 1-120, up to 164 gpm (24 hr) treated adit plus tailings water plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates, and 833 gpm (24 hr) must be disposed at the East Boulder Mine. Of the 833 gpm (24 hr), 293 gpm (24 hr) would be routed to LAD Area 6, and 540 gpm would be routed to the percolation pond. The remainder of the year (days 121-365), 737 gpm (24 hr) treated adit water would be disposed at the East Boulder Mine percolation pond. The time frame for closure is 12 months.

CLOSURE *Boe Ranch LAD and East Boulder Mine* Hydraulic Loading Calculations		**Assume the Boe Ranch LAD storage pond contains 100 MG on the first day of the LAD season at closure; 164 gpm treated adit plus tailings waters applied at the Boe Ranch LAD; at the East Boulder Mine: 293 gpm routed to LAD Area 6 and 540 gpm percolated**	
assumed volume in Boe Ranch LAD storage pond	100 MG	**1,157** gpm (12 hr)	rate to dewater **Boe Ranch LAD storage pond** in one season
volume of East Boulder tailings waters	40 MG	**260** gpm (24 hr)	rate to dewater the East Boulder tailings impoundment maximizing BTS/Anox system capacity and not exceeding total inorganic nitrogen limit
area available for LAD in section 17, all pivots included	194 ac	107 days	time to dewater the East Boulder tailings impoundment
agronomic land application rate proposed by SMC (KP 2000c)	7.7 gpm/ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates for 120 days on 194 acres, all Section 17 pivots
adit flow rate at closure	**737** gpm (24 hr)	**164** gpm (12 hr)	capacity available to land apply treated adit and tailings water at Boe Ranch LAD areas if Boe Ranch LAD storage pond dewatered at full rate
rate that treated adit and tailings waters must be percolated at East Boulder Mine so Boe Ranch LAD storage pond can be dewatered during one LAD season (days 1-107)	**833** gpm (24 hr)	**293** gpm (24 hr)	rate of land application at East Boulder Mine LAD Area 6 (full capacity)
rate of percolation of treated adit plus tailings waters at East Boulder Mine	**540** gpm (24 hr)	120 days	length of LAD season at Boe Ranch

***Boe Ranch LAD* Days 1-120: The hydraulic load of 164 gpm (24 hr) treated adit water and tailings waters plus disposal of 579 gpm (24 hr) Boe Ranch LAD stored waters will empty the LAD storage pond and can be managed at Boe Ranch LAD during one LAD season.**
***East Boulder Mine Days 1-120:* The hydraulic load of 293 gpm (24 hr) can be disposed at LAD Area 6, and the remaining 543 gpm (24 hr) can be disposed at the East Boulder Mine percolation pond. *East Boulder Mine Days 121-365:* The hydraulic load of 737 gpm (24 hr) treated adit water can be disposed at the East Boulder Mine percolation pond.**

CLOSURE East Boulder Mine Days 1-120: total inorganic nitrogen load at LAD Area 6	**2.1**	lbs/day	**27.8**	lbs/day	**CLOSURE East Boulder Mine Days 1-120: total inorganic nitrogen percolation load**
CLOSURE East Boulder Mine Days 1-120: total inorganic nitrogen load at percolation pond plus total inorganic nitrogen load at LAD Area 6	**540**	gpm (24 hr)	**29.9**	lbs/day	treated adit plus tailings waters
CLOSURE East Boulder Mine Days 121-365: total inorganic nitrogen load at percolation pond	**737**	gpm (24 hr)	**20.0**	lbs/day	treated adit waters

CLOSURE Throughout closure at the East Boulder Mine, the total inorganic nitrogen load produced from the disposal of 737 gpm (24 hr) of treated adit water would be less than the MPDES permit total inorganic nitrogen limit of 30 lbs/day.

CLOSURE *Boe Ranch LAD* : total inorganic nitrogen calculations Days 1-120			**Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch.**		
Boe Ranch LAD mixing zone input parameters			**737**	gpm (24 hr)	adit flow rate at closure (24 hr rate)
hydraulic load that can be land applied at Boe Ranch at agronomic rates for 120 days on 194 acres, all Section 17 pivots	**1,486**	gpm (12 hr)	**20**	lbs/day	historical maximum post-BTS/Anox total inorganic nitrogen load
pumping rate of treated tailings waters	**263**	gpm (24 hr)	2.3	mg/L	treated concentration of adit waters based on historical max concentration
weighted concentration of mixed waters in Boe Ranch LAD storage pond; assumes instantaneous mixing of waters	2.5	mg/L	10.0	mg/L	treated concentration of tailings waters based on 80% total inorganic nitrogen treatment efficiency
length of LAD season	120	days	4.3	mg/L	concentration of treated mixed adit plus tailings waters
depth of aquifer, **D**	15	ft	**4,597**	lbs	total total inorganic nitrogen load to ground water from LAD during closure
hydraulic conductivity, **k**	0.283	ft/d			mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10	ft			assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone LAD storage pond liner leakage, W_1	229	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_1	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_1	3,428	ft^2			D * W, allowed by 17.30.517(d)
Q_1=kiA, ground water available for mixing at liner leakage	97	ft^3/d			allowed by 17.30.517(d)
concentration of total inorganic nitrogen in ambient ground water; median value from RMW-3a, CA	0.1	mg/L			median ambient total inorganic nitrogen concentration derived from SMC monitoring data
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, L_2	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application mixing zone, W_2	3,593	ft			allowed by 17.30.517(d)
cross sectional area of aquifer at LAD application, A_2	53,901	ft^2			D * W, allowed by 17.30.517(d)
Q_2=kiA, ground water available for mixing at LAD application	1,525	ft^3/d			allowed by 17.30.517(d)
volume of LAD applied, 30% evaporation credit taken, V_2	100,129	ft^3/d	**1,040**	gpm (12 hr)	volume of LAD water applied; 30% evaporation credit taken
Days 1-120: Weighted average concentration of total inorganic nitrogen in applied LAD waters (adit water); assume 80% post plant uptake, C_2	0.7	mg/L			weighted concentration of mixed waters in Boe Ranch LAD storage pond; evaporation and plant uptake credits applied

volume of LAD storage pond liner leakage, **V_1**	27 ft^3/d		KP 2000c Apdx K, Tables
weighted total inorganic nitrogen concentration in LAD storage pond liner leakage discharge , **C_1**	2.5 mg/L	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, **L_3**	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, **W_3**	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, **A_3**	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of Mason Ditch (assumed to infiltrate), **V_3**	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assume total inorganic nitrogen in Mason Ditch equivalent to median concentration in EBR-007, **C_3**	0.1 mg/L		SMC monitoring data
CLOSURE *Boe Ranch LAD* Days 1-120: total inorganic nitrogen load in **ground water**		**Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch.**	
ground water total inorganic nitrogen concentration from Boe Ranch LAD storage pond liner leakage	0.6 mg/L		projected total inorganic nitrogen concentration in ground water
ground water total inorganic nitrogen concentration beneath LAD area from liner leakage & applied LAD	0.7 mg/L		projected total inorganic nitrogen concentration in ground water
ground water total inorganic nitrogen concentration at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	0.5 mg/L		projected total inorganic nitrogen concentration in ground water
CLOSURE total inorganic nitrogen concentration in **ground water downgradient of Mason Ditch, C_d**	**0.5** mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
CLOSURE The concentration of total inorganic nitrogen in ground water at Boe Ranch from the LAD of 743 gpm (12 hr) would be less than the DEQ-7 ground water standard of 10 mg/L.			
CLOSURE Boe Ranch LAD Days 1-120: East Boulder River total inorganic nitrogen concentration **downgradient of LAD**		**Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch.**	
receiving streamflow during non-irrigation season, **Q_s**	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow MPDES permit
receiving streamflow during irrigation season, **Q_s**	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow during irrigation season (CES 2008)
receiving stream ambient concentration, **C_s**	0.1 mg/L		SMC monitoring data
ground water discharge volume, **Q_d**	188,406 ft^3/d	2.2 cfs	ground water discharge volume in cubic feet per second
ground water concentration downgradient of Mason Ditch, **C_d**	0.5 mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
CLOSURE East Boulder River total inorganic nitrogen concentration, **downgradient of Boe Ranch LAD (5.0 cfs)**	**0.2** mg/L		projected total inorganic nitrogen concentration in the East Boulder River during irrigation season
CLOSURE East Boulder River total inorganic nitrogen concentration, **downgradient of Boe Ranch LAD (2.0 cfs)**	**0.3** mg/L		projected total inorganic nitrogen concentration in the East Boulder River during non-irrigation season
CLOSURE The total inorganic nitrogen concentration in the East Boulder River below the Boe Ranch LAD from disposal of 902 gpm (12 hr) would be less than 1.0 mg/L.			

Alternative 2C CLOSURE Option 1, 150 gpm: Days 1-120 Up to 150 gpm (24 hr) adit water would be mixed and treated with 286 gpm tailings waters and routed to the Boe Ranch LAD storage pond. The 436 gpm (24 hr) mixed, treated adit and tailings waters would mix with 52 MG of treated stored water in the LAD storage pond, then land applied at Boe Ranch LAD at agronomic rates 737 gpm (24 hr rate). Days 121-365 During the rest of the 12-month closure period, the 150 gpm (24 hr) would be routed to the East Boulder Mine percolation pond.

CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations		**Up to 436 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 52 MG treated adit water and land applied at 737 gpm at the Boe Ranch LAD area.**	
volume in LAD storage pond, assume 8 months winter storage of adit water	52 MG	40 MG	volume of the East Boulder Tailings impoundment waters needing disposal
pumping rate to empty **Boe Ranch LAD storage pond** at hydraulic capacity of LAD	**301** gpm (24 hr)	602 gpm (12 hr)	Boe Ranch LAD storage pond dewatering rate
pumping rate to dewater East Boulder **tailings impoundment**	**286** gpm (24 hr)	572 gpm (12 hr)	East Boulder Tailings impoundment dewatering rate
adit flow rate at closure	**150** gpm (24 hr)	300 gpm (12 hr)	adit flow rate
rate to dispose of all treated mine waters during 120 day LAD season	**1,474** gpm (12 hr)	**1,486** gpm (12 hr)	hydraulic capacity of Boe Ranch at agronomic rates on 194 acres, all Section 17 pivots
area available for LAD in section 17, all pivots included	194 ac	97 days	number of days to dewater **East Boulder tailings impoundment** at above rate
maximum agronomic application rate (KP Apdx K 2000)	7.7 gpm/ac	120 days	time to dewater the **LAD storage pond** at max agronomic LAD

Days 1-120: The hydraulic load of 150 gpm (24 hr) treated adit water plus 286 gpm (24 hr) treated tailings waters and 301 gpm (24 hr) Boe Ranch LAD stored waters can be managed at Boe Ranch LAD in one 120 day LAD season without managing any waters at the East Boulder Mine. Days 121-365: The hydraulic load of 150 gpm (24 hr) treated adit water can be managed at the East Boulder Mine percolation pond.

CLOSURE *East Boulder Mine* Days 121-365 nitrogen loading calculations		**Days 121-365, 150 gpm of adit water would be routed to the East Boulder Mine percolation pond**	
total inorganic nitrogen load to ground water from **percolation**	**20** lbs/day	**4,900** lbs/yr	Total total inorganic nitrogen load to ground water from percolation during closure
CLOSURE *Boe Ranch LAD* Days 1-120 nitrogen loading calculations		**Days 1-120, up to 436 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 52 MG treated adit water and land applied at Boe Ranch.**	
adit flow rate at closure	**150** gpm (24 hr)	737 gpm (24 hr)	adit water; no evaporation credit taken
historical maximum post BTS/Anox total inorganic nitrogen load	20 lbs/day	10 mg/L	concentration of treated tailings water based on 80% total inorganic nitrogen removal by BTS/Anox
treated concentration of adit waters based on historical max concentration	**11.1** mg/L	10.4 mg/L	weighted average of treated adit and tailings waters
Daily Load of total inorganic nitrogen disposed at **Boe Ranch LAD during CLOSURE**	**94.8** lbs/day	**58.6** lbs/ac/yr	**Total Load** of inorganic nitrogen disposed of **at Boe Ranch (120 days) per acre** during **CLOSURE**
Total Load of inorganic nitrogen Load disposed at **Boe Ranch LAD (120 days) during CLOSURE**	**11,372** lbs/yr		
depth of aquifer, **D**	15 ft	**10.7** mg/L	weighted average concentration of treated adit and treated East Boulder tailings waters with Boe Ranch LAD storage pond water; assume instantaneous mixing
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water

width of mixing zone LAD Storage Pond Liner Leakage, $\mathbf{W_1}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD Storage Pond Liner Leakage, $\mathbf{L_1}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD Storage Pond Liner Leakage, $\mathbf{A_1}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, ground water available for mixing at liner leakage	97 ft^3/d		allowed by 17.30.517(d)
concentration of total inorganic nitrogen in ambient ground water; median value from RMW-3a	0.1 mg/L		median adit total inorganic nitrogen concentration derived from SMC monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_2}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application mixing zone, $\mathbf{W_2}$	3,593 ft		allowed by 17.30.517(d)
cross sectional area of aquifer at LAD application, $\mathbf{A_2}$	53,901 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_2}$=kiA, ground water available for mixing at LAD application	1,525 ft^3/d		allowed by 17.30.517(d)
volume of applied LAD; end of pipe, pre-evaporation at adit flow rate, $\mathbf{V_2}$	283,765 ft^3/d	**1,474** gpm (12 hr)	adit water; no evaporation credit taken
Concentration of total inorganic nitrogen in applied LAD waters (treated adit, tailings, and stored waters); assume 80% post plant uptake, $\mathbf{C_2}$	3.1 mg/L		weighted average used assuming instantaneous mixing of waters in LAD storage pond
volume of LAD Storage Pond liner leakage	27 ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of Aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_3}$=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of flow in Mason Ditch assumed to infiltrate to ground water, $\mathbf{V_3}$	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assume total inorganic nitrogen in Mason Ditch equivalent to median value EBR-007, $\mathbf{C_3}$	0.1 mg/L		SMC monitoring data

CLOSURE *Boe Ranch LAD* : Days 1-120 inorganic nitrogen concentration in **ground water**			**Up to 436 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 52 MG treated adit water and land applied at 737 gpm (24 hr) at the Boe Ranch.**
total inorganic nitrogen concentration in ground water from Boe Ranch LAD storage pond liner leakage	2.4 mg/L		projected total inorganic nitrogen concentration in ground water
total inorganic nitrogen concentration in ground water beneath LAD area from liner leakage & applied LAD	3.0 mg/L		projected total inorganic nitrogen concentration in ground water
total inorganic nitrogen concentration in ground water at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	2.5 mg/L		projected total inorganic nitrogen concentration in ground water
CLOSURE total inorganic nitrogen ground water concentration downgradient of Mason Ditch, C_d	**2.0** mg/L		projected total inorganic nitrogen concentration in ground water
CLOSURE The concentration of total inorganic nitrogen in ground water at Boe Ranch from the LAD of 737 gpm (24 hr) would be less than the DEQ-7 ground water standard of 10 mg/L.			
CLOSURE *Boe Ranch* LAD: Days 1-120 inorganic nitrogen concentration in the **East Boulder River**			**Up to 436 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 52 MG treated adit water and land applied at 737 gpm (24 hr) at the Boe Ranch.**
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow during irrigation season (CES 2008)
receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow
receiving stream ambient concentration, C_s	0.1 mg/L		SMC monitoring data
ground water discharge volume, Q_d	245,159 ft^3/d	2.8 cfs	ground water discharge volume in cubic feet per second
ground water concentration below Mason Ditch, C_d	2.0 mg/L		projected total inorganic nitrogen concentration in ground water
East Boulder River total inorganic nitrogen concentration **downgradient of Boe Ranch LAD during irrigation season (2.0 cfs)**	1.2 mg/L		projected total inorganic nitrogen concentration in the East Boulder River during irrigation season
East Boulder River total inorganic nitrogen concentration **downgradient of Boe Ranch LAD during non-irrigation season (5.0 cfs)**	**0.8** mg/L		projected total inorganic nitrogen concentration in the East Boulder River during non-irrigation season
CLOSURE The total inorganic nitrogen concentration in the East Boulder River below the Boe Ranch LAD from disposal of 150 gpm (24 hr) would exceed the 1.0 mg/L MPDES Permit nitrogen limit if the flow in the East Boulder River was less than 3.0 cfs.			

Spreadsheet 2C Salts: Proposed Action Alternative 2C Boe Ranch LAD System Operations and Closure Salinity Analyses

Per KP 2000c, if the Boe Ranch LAD were constructed it would be the preferred disposal option for treated adit water during operations and for treated adit and tailings waters at closure. The East Boulder Mine percolation pond would be used for contingency disposal of treated adit water during operations. Monitoring well RMW-3A is located at Boe Ranch down-gradient of the proposed LAD and is considered to represent ambient electrical conductivity (EC) values. Based on EC measurements at RMW-3A, the ground water at Boe Ranch LAD is designated as Class II Beneficial Use with an electrical conductivity criterion of 1,000 to 2,500 µSiemens/cm (equivalent to µmhos/cm). The baseline median concentrations of TDS in the East Boulder River were 270 mg/L at EBR-007 and 340 mg/L at EBR-008. At closure, all adit and East Boulder tailings waters would be treated for nitrogen through the BTS/Anox system then routed to Boe Ranch LAD storage pond all year and disposed through LAD pivots during the summer LAD season. For the Boe Ranch LAD, calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones.

precipitation (recharge) was assumed. For the Boe Ranch LAD any water that percolates below the root zone is assumed to immediately enter the aquifer. It is assumed that the Boe Ranch LAD area would not have an MPDES permit. Salts are not treated in the BTS/Anox system or during LAD, so all concentrations of salt are expected to flush through the soil column then to ground water. Ground water flows beneath the LAD area and LAD storage pond, flows down-gradient where it is recharged by the Mason Ditch, then discharges to the East Boulder River. These calculations assume that during operations, treated adit waters are preferentially routed to the Boe Ranch LAD storage pond then to the mine percolation pond. PoleCat evaporators accomplish summer 30% evaporation, center pivots 30%; PoleCat winter snowmaking 30% evaporation up slope of the lined LAD storage pond. At closure, treated adit and tailings waters would be routed to the Boe Ranch LAD storage pond which would hold 100 MG of adit waters, and mixing of

these waters occurs prior to disposal at the LAD pivots. A weighted average was used to determine the concentration of salts in the mixed LAD storage pond water. The East Boulder mine MPDES has no total dissolved solids (TDS) or electrical conductivity (EC) limits. Median adit and tailings TDS concentrations were used in these calculations. Salts loading is calculated using TDS concentrations. These calculations assume that there will be a leak in the Boe Ranch LAD storage pond, and the liner leakage, applied LAD, and Mason Ditch waters contribute to ground water quality prior to discharge into the East Boulder River. It is assumed that all 10 proposed Boe Ranch LAD center pivots on 194 acres in Section 17 will be developed for use at agronomic rates during operations and closure. The agencies used a 250 mg/L TDS recommendation for aquatic effects.

OPERATIONS CALCULATIONS

The Alternative 2C Salts OPERATIONS Option 1, 737 gpm: Preferential disposal of all 737 gpm adit water Boe Ranch LAD at agronomic rates with contingency disposal of treated adit water at the East Boulder Mine percolation pond. Treated adit water stored in the Boe Ranch LAD storage pond over fall, winter, and early spring would also have to be disposed during the LAD season.

Assume the BTS/Anox nitrogen treatment capacity is 1000 gpm for 24 hours

Boe Ranch LAD design capacity is 1,486 gpm for 12 hr rate (743 gpm for 24 hr rate)
1 ppm TDS = 1.56 µmhos/cm

OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations		assume Boe Ranch LAD storage pond contains 100 MG treated adit water on the first day of the LAD season; disposal of 737 gpm treated adit water at Boe Ranch LAD	
volume of LAD Storage Pond	100 MG	120 days	length of LAD season
area available for LAD in section 17, all pivots included	194 ac	95 days	time to fill the Boe Ranch LAD storage pond at 737 gpm after the LAD season
agronomic application rate (KP Apdx K 2000) 12 hr/day	7.7 gpm/ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates on 194 acres, all ten pivots in Section 17
adit flow rate	**737** gpm (24 hr)	1,474 gpm (12 hr)	adit flow rate
rate to dewater Boe Ranch LAD storage pond in one season	**579** gpm (24 hr)	1,157 gpm (12 hr)	rate to dewater Boe Ranch LAD storage pond in one season
rate treated adit water must be **percolated** at East Boulder Mine to dewater the Boe Ranch LAD storage pond **(days 1-120)**	**573** gpm (24 hr)	**164** gpm (24 hr)	rate treated adit water can be disposed at **Boe Ranch LAD** to meet available capacity
rate treated adit water is pumped from East Boulder Mine to **fill Boe Ranch LAD storage pond (days 121-365)**	**283** gpm (24 hr)	**454** gpm (24 hr)	rate that treated adit water is **percolated** at East Boulder Mine percolation pond for the remainder of the year **(days 121-365)**

OPERATIONS *Boe Ranch LAD* During the LAD season, the hydraulic load of 737 gpm adit water can be managed at Boe Ranch LAD area if all 10 pivots are operating at agronomic rates as proposed by SMC (KP 2000c). However, the LAD storage pond would fill the first 95 days of winter and excess adit waters would have to be managed at the East Boulder Mine. During the following LAD season, the hydraulic load of 737 gpm adit water could be managed at Boe Ranch LAD area at agronomic rates, but the LAD storage pond could not be dewatered at the Boe Ranch LAD area. Essentially, the adit water would be managed as in Alternatives 1B and 2B at the East Boulder Mine with similar impacts.

OPERATIONS *Boe Ranch LAD* To operationally address the hydraulic volume of adit water and to annually dewater the Boe Ranch LAD storage pond during the LAD season, 164 gpm treated adit water can be land applied at Boe Ranch using agronomic rates, and the remaining 454 gpm must be disposed at the East Boulder Mine percolation pond. During the rest of the year, 283 gpm treated adit water would be routed to the Boe Ranch LAD storage pond, and 454 gpm treated adit water would be percolated at the East Boulder Mine percolation pond.

The Alternative 2C Salts OPERATIONS Option 2, 737 gpm: During the LAD season days 1-120, up to 164 gpm (24 hr) treated adit water plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates, and 573 gpm (24 hr) is disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 283 gpm (24 hr) treated adit water can be routed to the Boe Ranch LAD storage pond and up to 454 gpm (24 hr) would be disposed at the East Boulder Mine percolation pond.

OPERATIONS *East Boulder Mine* Salinity Calculations			**The ground water at the East Boulder Mine meets the Class I Beneficial Use criterion. Percolation of treated adit waters at East Boulder Mine; Days 1-120, 573 gpm water in excess of the LAD capability at the Boe Ranch LAD; Days 121-365, 454 gpm water percolated in excess of water routed to the Boe Ranch LAD storage pond**		
East Boulder Source-Specific percolation pond mixing zone imputs			**573**	gpm (24 hr)	treated **adit water percolated** at East Boulder Mine percolation pond **days 1-120**
depth of aquifer, **D**	80	ft			MPDES Permit Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d			MPDES Permit Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Permit Statement of Basis, p. 25-26
width of source	385	ft			MPDES Permit Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600	ft			MPDES Permit Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Permit Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Permit Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm			MPDES Permit Statement of Basis, p. 25-26
upgradient ground water TDS concentration in WW-1, $\mathbf{C_A}$	106	mg/L	165	µmhos/cm	CES 2008 Apdx D, EBoulder Mine TDS Table p 2, central value
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2			D * W, allowed by 17.30.517(d)
70% Volume of ground water available for mixing $\mathbf{Q_1}$=kiA_1	109,156	ft^3/d			MPDES Permit Statement of Basis, p.25-26
Volume of adit water percolated during LAD season **days 1-120**, $\mathbf{V_p}$	110,249	ft^3/d	87,315	ft^3/d	Volume of adit water percolated **days 121-365**, $\mathbf{V_p}$
depth of aquifer, $\mathbf{D_2}$	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	75	ft/d			MPDES Permit Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Permit Statement of Basis, p. 25-26
width of source	700	ft			MPDES Permit Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Permit Statement of Basis, p. 25-26
angle of dispersion	0.08742169	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2			D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
concentration of salt in adit water	**550**	mg/L	858	µmhos/cm	2000-2008 median East Boulder adit TDS concentration; CES 2008 page 13
receiving stream baseline ambient concentration at EBR-001, $\mathbf{Q_c}$	49	mg/L	76	µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
receiving streamflow, $\mathbf{Q_s}$	423,000	ft^3/d	5	cfs	7Q10 at Boulder River USGS gaging station; MPDES Permit Statement of Basis page 4
OPERATIONS *East Boulder Mine* (LAD Season days 1-120) Salt concentration in ground water	304	mg/L	**474**	µmhos/cm	projected salt concentration in ground water at SP-11
OPERATIONS *East Boulder Mine* (LAD Season days 1-120) Salt concentration in East Boulder River below East Boulder Mine	**143**	mg/L	223	µmhos/cm	projected salt concentration in the East Boulder River at EBR-004A

OPERATIONS *East Boulder Mine* (days 121-365) Salt concentration in ground water	279 mg/L	**435** µmhos/cm	projected salt concentration in ground water at SP-11
OPERATIONS *East Boulder Mine* (days 121-365) Salt concentration in East Boulder River below East Boulder Mine	**137** mg/L	214 µmhos/cm	projected salt concentration in the East Boulder River at EBR-004A
OPERATIONS *East Boulder Mine* Percolation of 454 to 573 gpm (24 hr) treated adit water at the East Boulder Mine meets ground water Class I Beneficial Use and recommended surface water TDS concentration protective of trout eggs.			
OPERATIONS *Boe Ranch LAD* Salinity Calculations, days 1-120		**During the LAD season days 1-120, up to 164 gpm (24 hr rate) treated adit water plus 579 gpm (24 hr rate) stored pond water is applied at Boe Ranch LAD at agronomic rates**	
volume of adit plus stored water applied at Boe Ranch LAD, **days 1-120**	**1,486** gpm (12 hr)	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates on 194 acres, all ten pivots
2000-2008 median East Boulder adit EC concentration calculated from SMC Monitoring Data	858 µmhos	550 mg/L	2000-2008 median East Boulder adit TDS concentration; SMC Monitoring Data
OPERATIONS *Boe Ranch LAD* Daily salt load	**4,904** lbs/day	**25.3** lbs/ac/yr	**OPERATIONS *Boe Ranch LAD Total LAD season* Salt load per acre**
OPERATIONS *Boe Ranch LAD* Total LAD season salt Load	**588,472** lbs/yr		
depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone LAD Storage Pond Liner Leakage, $\mathbf{W_1}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD Storage Pond Liner Leakage, $\mathbf{L_1}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD Storage Pond Liner Leakage, $\mathbf{A_1}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, ground water available for mixing at liner leakage	97 ft^3/d		allowed by 17.30.517(d)
concentration of EC in ambient ground water; median value from RMW-3a, $\mathbf{C_A}$	1,125 µmhos/cm	721 mg/L	median ambient ground water TDS concentration derrived from SMC monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_2}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application mixing zone, $\mathbf{W_2}$	3,593 ft		allowed by 17.30.517(d)
cross sectional area of aquifer at LAD application, $\mathbf{A_2}$	53,901 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_2}$=kiA, ground water available for mixing at LAD application	1,525 ft^3/d		allowed by 17.30.517(d)
volume of applied LAD, $\mathbf{V_2}$	143,041 ft^3/d	**1,486** gpm (24 hr)	hydraulic load that can be land applied at agronomic rates on 194 acres, all ten pivots
effective calculated EC in applied LAD waters (adit water); assume pivots 30% evaporation, $\mathbf{C_2}$	1,226 µmhos/cm	786 mg/L	effective applied LAD TDS concentration due to evaporation
volume of LAD Storage Pond liner leakage, $\mathbf{V_1}$	27 ft3/d	0.14 gpm	KP 2000c Apdx K, Tables
calculated EC in LAD Storage Pond liner leakage discharge (adit water), $\mathbf{C_1}$	858 µmhos/cm	550 mg/L	median adit TDS concentration derrived from SMC monitoring data
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables

length between end of pivots to East Boulder River, L_3	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of Mason Ditch that is assumed to infiltrate, V_3	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
OPERATIONS *Boe Ranch LAD* Ground water salts concentration (LAD season)		**During the LAD season, up to 164 gpm (24 hr) plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates. The ground water at Boe Ranch has a Class II Beneficial Use, 1,000 to 2,500 µmhos/cm.**	
assume TDS in Mason Ditch equivalent to median TDS concentration at EBR-007, C_3	421 µmhos/cm	**270** mg/L	SMC monitoring data 2000-2004; EC calculated from TDS
EC of ground water beneath Boe Ranch LAD storage pond from liner leakage	1,067 µmhos/cm	684 mg/L	TDS value calculated from EC
EC of ground water below LAD area from liner leakage plus applied LAD	1,224 µmhos/cm	785 mg/L	TDS value calculated from EC; hydraulic evaporation credit taken for LAD
EC of ground water below Mason Ditch from liner leakage, applied LAD, and Mason Ditch seepage	985 µmhos/cm	631 mg/L	TDS value calculated from EC; hydraulic evaporation credit taken for LAD
OPERATIONS EC of ground water below Mason Ditch (Boe Ranch), C_d	**1,041 µmhos**	667 mg/L	TDS value calculated from EC; projected salts concentration in ground water just prior to discharge to East Boulder River above EBR-008
OPERATIONS *Boe Ranch LAD* Land application of 743 gpm (24 hr) treated adit water plus stored pond water at agronomic rates is less than the 2,500 µmhos/cm Class II Beneficial Use criterion.			
OPERATIONS *Boe Ranch LAD* East Boulder River salts concentrations, days 1-120		**During the LAD season, up to 164 gpm (24 hr) plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates. The East Boulder River ambient TDS concentration at EBR-007 is 270 mg/L, and ambient concentration at EBR-008 is 340 mg/L.**	
receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow assumed at EBR-008, non-irrigation season
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value at EBR-008 streamflow after irrigation withdrawals below Boe Ranch LAD (CES 2008)
receiving stream ambient concentration, C_s	421 µmhos	**270** mg/L	median value for EBR-007 SMC Monitoring data, 2000-2004
ground water discharge volume, Q_d	146,652 ft^3/d	1.7 cfs	volume of ground water discharge to East Boulder River below Boe Ranch LAD
ground water concentration downgradient of Mason Ditch, C_d	1,041 µmhos/cm	667 mg/L	salt concentration in ground water just prior to discharge to East Boulder River
OPERATIONS East Boulder River TDS concentration downgradient of the Boe Ranch LAD area (2.0 cfs)	706 µmhos/cm	452 mg/L	TDS value calculated from EC; projected salts concentration at EBR-008 during low flow at irrigation season; **this is an increase of 33% above ambient TDS**
OPERATIONS East Boulder River TDS concentration downgradient of the Boe Ranch LAD area at 7Q10 flow (5.0 cfs)	578 µmhos/cm	371 mg/L	TDS value calculated from EC; projected salts concentration at EBR-008 during 7Q10 low flow; **this is an increase of 9% above ambient TDS**

OPERATIONS Land application disposal of 743 gpm (24 hr) Boe Ranch LAD storage pond waters would produce an increased TDS concentration in the East Boulder River at EBR-008 above the ambient median TDS concentration of 340 mg/L. Given the median TDS concentration of adit water, no volume of adit water can be land applied to reduce the TDS concentration in the East Boulder River below Boe Ranch. The ambient concentration is above the recommended TDS concentration of 250 mg/L to protect fish eggs.

The Alternative 2C Salts OPERATIONS Option 1, 150 gpm: During the LAD season days 1-120, up to 150 gpm (24 hr) treated adit water plus 301 gpm (24 hr) stored pond water would be applied at Boe Ranch LAD at agronomic rates. No water would be disposed at the East Boulder Mine percolation pond. The remainder of the year (days 121-365), 150 gpm (24 hr) treated adit water would be routed to the Boe Ranch LAD storage pond. The capacity of the Boe Ranch LAD storage pond would be adequate to store eight months of treated adit water (52 MG).

OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations days 1-120

Assume Boe Ranch LAD storage pond contains 52 MG treated adit water on the first day of the LAD season; disposal of 150 gpm treated adit water plus 602 gpm (12 hr) stored waters at Boe Ranch LAD

Boe Ranch LAD storage pond capacity is sufficient for 8 months storage of adit water at 150 gpm

capacity of LAD Storage Pond	100 MG			
volume in LAD storage pond, assume 8 months stored at 150 gpm	52 MG	120 days	length of LAD season	
pumping rate to empty LAD storage pond during the LAD season	301 gpm (24 hr)	602 gpm (12 hr)	pumping rate to empty LAD storage pond during the LAD season	
area available for LAD in section 17, all pivots included	194 ac	**1,486** gpm (12 hr)	hydraulic load that can be land applied at agronomic rates on 194 acres, all ten pivots in Section 17	
agronomic application rate (KP Apdx K 2000) 12 hr/day	7.7 gpm/ac	300 gpm (12 hr)	adit flow rate at closure	
adit flow rate at closure	**150** gpm (24 hr)	**902** gpm (12 hr)	hydraulic load of treated adit water plus stored LAD pond waters	
amount of water that would be percolated at East Boulder Mine	**0** gpm (24 hr)	**0** gpm (12 hr)	amount of water that would be percolated at East Boulder Mine	

OPERATIONS During the 120 day LAD season, the hydraulic load of 150 gpm (24 hr) adit water plus 602 gpm (12 hr) rate of dewatering 8 months stored water in the LAD storage pond (52 MG) can be managed at Boe Ranch LAD area if all 10 pivots are operating at the proposed agronomic rates.

OPERATIONS *Boe Ranch LAD* Salinity Calculations days 1-120

Assume Boe Ranch LAD storage pond contains 52 MG treated adit water on the first day of the LAD season; disposal of 150 gpm treated adit water plus 602 gpm (12 hr) stored waters at Boe Ranch LAD

2000-2008 median adit EC, calculated from SMC Monitoring Data	858 μmhos/cm	**550** mg/L	2000-2008 median adit TDS concentration SMC Monitoring Data
OPERATIONS *Boe Ranch LAD* Daily salt load	**2,976** lbs/day	**0.7** lbs/ac/yr	**OPERATIONS *Boe Ranch LAD Total LAD season* Salt load per acre**
OPERATIONS *Boe Ranch LAD* Total LAD season salt Load	**357,133** lbs/yr		
depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone LAD Storage Pond Liner Leakage, $\mathbf{W_1}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD Storage Pond Liner Leakage, $\mathbf{L_1}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD Storage Pond Liner Leakage, $\mathbf{A_1}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, ground water available for mixing at storage pond liner leakage	97 ft^3/d		allowed by 17.30.517(d)
EC of ambient ground water; median value from RMW-3a, $\mathbf{C_A}$	1,125 μmhos/cm	721 mg/L	SMC monitoring data 2000-2005
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_2}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application mixing zone, $\mathbf{W_2}$	3,593 ft		allowed by 17.30.517(d)
cross sectional area of aquifer at LAD application, $\mathbf{A_2}$	53,901 ft^2		D * W, allowed by 17.30.517(d)

Q_2=kiA, ground water available for mixing at LAD application	1,525 ft^3/d		allowed by 17.30.517(d)
volume of applied LAD evaporation credit taken, **V_2**	121,533 ft^3/d	**902** gpm (12 hr)	adit plus stored Boe Ranch LAD storage pond water; no evaporation credit taken
effective calculated EC in applied LAD waters (adit water); assume pivots 30% evaporation, **C_2**	1,226 μmhos/cm	786 mg/L	effective applied LAD TDS concentration
volume of LAD Storage Pond liner leakage, **V_1**	27 ft3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
EC in LAD Storage Pond liner leakage discharge (adit water), **C_1**	858 μmhos/cm	550 mg/L	median adit TDS concentration derived from SMC monitoring data
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, **L_3**	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, **W_3**	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of Aquifer between pivots to East Boulder River, **A_3**	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, ground water available for mixing below Mason Ditch to East Boulder River	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of flow in Mason Ditch assumed to infiltrate to ground water, **V_3**	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assume TDS in Mason Ditch equivalent to median TDS concentration at EBR-007, **C_3**	421 μmhos/cm	270 mg/L	2000-2004 SMC Monitoring Data; EC value calculated from TDS
ground water TDS concentration from Boe Ranch LAD storage pond liner leakage	1,067 μmhos/cm	684 mg/L	TDS value calculated from EC; projected concentration in ground water
ground water TDS concentration beneath LAD area from liner leakage & applied LAD	1,224 μmhos/cm	784 mg/L	TDS value calculated from EC; hydraulic evaporation credit taken for LAD
ground water TDS concentration at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	957 μmhos/cm	613 mg/L	TDS value calculated from EC
OPERATIONS *Boe Ranch LAD* ground water salts concentration below Mason Ditch, C_d	**1,017** μmhos/cm	652 mg/L	TDS value calculated from EC; projected salts concentration in ground water just prior to discharge to East Boulder River above EBR-008

OPERATIONS *Boe Ranch LAD* the EC in ground water just prior to discharge to the East Boulder River meets the 2,500 μmhos/cm Class II Beneficial Use Criterion.

receiving streamflow, **Q_s**	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow during irrigation season
receiving stream ambient concentration at EBR-007, **C_s**	421 μmhos/cm	**270** mg/L	median value, SMC monitoring data 2000-2004 at EBR-007
ground water discharge volume, **Q_d**	168,056 ft^3/d	2.0 cfs	irrigation season East Boulder River streamflow (CES 2008)
ground water concentration below Mason Ditch, **C_d**	1,017 μmhos/cm	652 mg/L	salt concentration in ground water just prior to discharge to East Boulder River
OPERATIONS *Boe Ranch LAD* East Boulder River TDS concentration during the irrigation season (2.0 cfs)	715 μmhos/cm	**458 mg/L**	TDS value calculated from EC; **this is an increase of 35% above ambient TDS**
OPERATIONS *Boe Ranch LAD* East Boulder River TDS concentration at 7Q10 flow (5.0 cfs)	**377 mg/L**	5.0 cfs	7Q10 value for East Boulder Mine streamflow; **this is an increase of 11% above ambient TDS**

OPERATIONS *Boe Ranch LAD* Land application disposal of 902 gpm (12 hr) Boe Ranch LAD storage pond waters would produce an increased TDS concentration in the East Boulder River above the ambient TDS concentration of 340 mg/L at EBR-008. Given the ambient TDS concentration in the East Boulder River and the median TDS concentration of adit water, no volume of adit water could be land applied at a rate that would reduce the TDS concentration in the East Boulder River below Boe Ranch. The ambient concentration at EBR-008 is above the recommended TDS concentration of 250 mg/L protective of trout eggs.

OPERATIONS *East Boulder Mine LAD* Salinity Calculations days 1-120				**No percolation would occur at East Boulder Mine days 1-120**
OPERATIONS *East Boulder Mine LAD* Salinity Calculations days 121-365				**The remainder of the year (days 121-365), 150 gpm (24 hr) treated adit water would be routed to the Boe Ranch LAD storage pond.**
OPERATIONS (days 121-365) Salt concentration in ground water below East Boulder Mine	**286** µmhos/cm			projected salt concentration in ground water at SP-11
OPERATIONS (days 121-365) Salt concentration in East Boulder River below East Boulder Mine	**87** mg/L			projected salt concentration in the East Boulder River at EBR-004A

OPERATIONS *East Boulder Mine* the EC in ground water just prior to discharge to the East Boulder River meets the 1,000 µmhos/cm Class I Beneficial Use Criterion, and the TDS concentration in the East Boulder River is less than the 250 mg/L TDS recommendation for the protection of trout eggs.

CLOSURE CALCULATIONS

The Proposed Action Alternative 2C Salts CLOSURE Option 1, 737 gpm: The East Boulder tailings impoundment would be dewatered and tailings waters treated at 260 gpm (24 hr) with 737 gpm (24 hr) adit water through the BTS/Anox. Based on the Operations hydraulic load calculations, only 743 gpm (24 hr) can be disposed at Boe Ranch LAD. During the LAD season days 1-120, up to 164 gpm (24 hr) treated adit plus tailings water plus 579 gpm (24 hr) stored pond water is applied at Boe Ranch LAD at agronomic rates, and 833 gpm (24 hr) must be disposed of at the East Boulder Mine. Of the 833 gpm (24 hr), 293 gpm (24 hr) would be routed to LAD Area 6, and 540 gpm would be routed to the percolation pond. The remainder of the year (days 121-365), 737 gpm (24 hr) treated adit water would be disposed at the East Boulder Mine percolation pond. The time frame for closure is 12 months.

858 µmhos/cm	**550** mg/L	2000-2008 median adit TDS concentration; SMC Monitoring Data
1,399 µmhos/cm	**897** mg/L	2002-2006 median tailings waters TDS concentration SMC Monitoring Data
999 µmhos/cm	**640** mg/L	weighted average concentration of adit plus tailings waters; assume instantaneous mixing of mine waters; no salt treatment occurs in BTS/Anox system days 1-107

CLOSURE *East Boulder Mine and Boe Ranch LAD* Hydraulic Loading days 1-120

Assume the Boe Ranch LAD storage pond contains 100 MG on the first day of the LAD season at closure

area available for LAD in section 17, all ten pivots	194 ac	7.7 gpm/ac	agronomic land application rate proposed by SMC (KP 2000C)
capacity to dispose of all treated mine waters during 120 day LAD season	743 gpm (24 hr)	**1,486** gpm (12 hr)	total capacity to dispose of all treated mine waters during 120 day LAD season
adit flow rate at closure	**737** gpm (24 hr)	1,474 gpm (12 hr)	adit flow rate
assumed volume in LAD storage pond at beginning of closure	100 MG	40 MG	volume of the East Boulder Tailings impoundment waters needing disposal
pumping rate to empty LAD storage pond in 120 days	579 gpm (24 hr)	**1,157** gpm (12 hr)	rate to dewater LAD storage pond in 120 days
rate to dewater East Boulder tailings impoundment	**260** gpm (24 hr)	107 days	number of days to dewater East Boulder tailings impoundment
rate that treated adit and tailings waters must be managed at East Boulder Mine to dewatered Boe Ranch LAD storage pond during one LAD season (days 1-106)	**833** gpm (24 hr)	**164** gpm (24 hr)	capacity available to land apply treated adit and tailings water at Boe Ranch LAD areas if Boe Ranch LAD storage pond was dewatered at full rate
rate of percolation of treated adit plus tailings waters	**540** gpm (24 hr)	**293** gpm (24 hr)	rate of land application at East Boulder Mine LAD Area 6 (full capacity)

***CLOSURE Boe Ranch LAD* Days 1-120: The hydraulic load of 164 gpm (24 hr) treated adit water and tailings waters plus disposal of 579 gpm (24 hr) Boe Ranch LAD stored waters will empty the LAD storage pond and can be managed at Boe Ranch LAD during one LAD season. *East Boulder Mine* Days 1-120: The hydraulic load of 293 gpm (24 hr) can be disposed at LAD Area 6, and the remaining 540 gpm (24 hr) can be disposed at the East Boulder Mine percolation pond. East Boulder Mine Days 121-365: The hydraulic load of 737 gpm (24 hr) treated adit water can be disposed at the East Boulder Mine percolation pond.**

CLOSURE *East Boulder Mine* Days 1-120: Salinity Calculations

Up to 293 gpm treated adit plus tailings waters would be disposed of at LAD Area 6; the remaining 540 gpm treated adit plus tailings waters would be disposed of in the East Boulder Mine percolation pond.

area of East Boulder Mine LAD Area 6 (CES 2008)	10.2	ac	**245**	days	remainder of the year after the LAD season
CLOSURE *East Boulder Mine* Daily salt load disposed of at *LAD Area 6* (days 1-120)	**2,217**	lbs/day	**400**	lbs/ac/yr	**CLOSURE *East Boulder Mine* Daily salt load disposed of per acre at *LAD Area 6* (days 1-120)**
CLOSURE *East Boulder Mine* Daily salt load disposed of at the *percolation pond* (days 1-120)	**4,084**	lbs/day	**0.0**	lbs/ac/yr	**CLOSURE *East Boulder Mine* Daily salt load disposed of per square foot at *LAD Area 6* (days 1-120)**
CLOSURE *East Boulder Mine* Daily salt load disposed of at the *percolation pond* (days 121-365)	**4,864**	lbs/day	**1,947,818**	lbs/yr	**CLOSURE *East Boulder Mine* Total salt load disposed of (LAD plus percolation) Days 1-365**
depth of aquifer, **D**	80	ft			MPDES Permit Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d			MPDES Permit Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Permit Statement of Basis, p. 25-26
width of source	385	ft			MPDES Permit Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600	ft			MPDES Permit Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Permit Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Permit Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm			MPDES Permit Statement of Basis, p. 25-26
upgradient concentration of TDS in ground water (at WW-1), $\mathbf{C_A}$	97	mg/L			1989-2009 SMC Monitoring Data median value
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2			D * W, allowed by 17.30.517(d)
70% Volume of aquifer available for mixing $\mathbf{Q_1}$=kiA$_1$	109,156	ft^3/d			MPDES Permit Statement of Basis, p. 25-26
Volume of adit water percolated days 1-120, $\mathbf{V_p}$	103,896	ft^3/d	**540**	gpm (24 hr)	treated adit & tailings waters disposed at East Boulder Mine percolation pond days 1-120
depth of aquifer MPDES Permit Statement of Basis, p. 25-26, $\mathbf{D_2}$	15	ft	**737**	gpm (24 hr)	treated adit & tailings waters disposed at East Boulder Mine percolation pond days 121-365
hydraulic conductivity MPDES Permit Statement of Basis, p. 25-26, **k**	75	ft/d	141,882	ft^3/d	Volume of adit water percolated days 121-365, $\mathbf{V_p}$
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	700	ft			MPDES Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2			D * W, allowed by 17.30.517(d)
Volume of aquifer available for mixing below tailings impoundment $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
weighted average TDS concentration of adit plus tailings waters, $\mathbf{C_P}$	640	mg/L	999	µmhos/cm	weighted average concentration of adit plus tailings waters; assume instantaneous mixing of mine waters
receiving stream ambient concentration at EBR-001, $\mathbf{Q_c}$	45	mg/L	76	µmhos/cm	1989-2009 SMC Monitoring Data median value
receiving streamflow, $\mathbf{Q_s}$	423,000	ft^3/d	5	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4

effective calculated TDS in applied waters LAD Area 6; assume pivots 30% evaporation, **C_2**	915 mg/L	293 gpm (24 hr)	rate of land application at East Boulder Mine LAD Area 6 (full capacity)
volume of applied LAD with evaporation credit taken, **V_2**	39,484 ft^3/d		
		Up to 293 gpm treated adit plus tailings waters would be disposed of at LAD Area 6; the remaining 540 gpm treated adit plus tailings waters would be disposed of in the East Boulder Mine percolation pond.	
CLOSURE *East Boulder Mine* Days 1-120: Salt concentration in ground water	414 mg/L	**645** µmhos/cm	projected salt concentration in ground water at SP-11
CLOSURE *East Boulder Mine* Days 1-120 Salt concentration in East Boulder River below East Boulder Mine	**192** mg/L	299 µmhos/cm	projected salt concentration in the East Boulder River at EBR-004A
CLOSURE *East Boulder Mine* Days 121-365: Salt concentration in ground water	327 mg/L	**511** µmhos/cm	projected salt concentration in ground water at SP-11
CLOSURE *East Boulder Mine* Days 121-365 Salt concentration in East Boulder River below East Boulder Mine	**157** mg/L	245 µmhos/cm	projected salt concentration in the East Boulder River at EBR-004A

CLOSURE 737 gpm (24 hr) Option 1 the EC of ground water at East Boulder Mine meets the Class I Beneficial Use Criterion of 1,000 µmhos/cm. The TDS concentration in the East Boulder River at the East Boulder Mine is less than the 250 mg/L recommendation to protect trout eggs.

CLOSURE *Boe Ranch LAD* Days 1-120: Salinity Calculations

Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch. The ground water at Boe Ranch has a Class II Beneficial Use.

depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone, **W_1**	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length, **L_1**	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer, **A_1**	3,428 ft^2		D * W, allowed by 17.30.517(d)
ground water available for mixing at liner leakage, **Q_1**=kiA	97 ft^3/d		KP 2000c Apdx K, Tables
EC of ambient ground water; median value from RMW-3a, **C_A**	721 mg/L	1,125 µmhos	EC calculated from RMW-3 median TDS value at Boe Ranch proposed LAD area; 2000-2005 SMC Monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application,**L_2**	4,500 ft		KP 2000c Apdx K, Tables
width of mixing zone, **W_2**	3,593 ft		allowed by 17.30.517(d)
cross sectional area of aquifer, **A_2**	53,901 ft^2		D * W, allowed by 17.30.517(d)
Q_2=kiA, ground water available for mixing	1,525 ft^3/d	743 gpm (24 hr)	volume of applied treated mine waters during 120 day LAD season
volume of applied LAD, 30% evaporation applied, **V_2**	100,129 ft^3/d	**568** mg/L	weighted TDS concentration of mixed adit, tailings, and stored waters in LAD storage pond days 1-120
calculated EC in applied LAD (mixed waters); evaporation applied, **C_2**	1,265 µmhos	811 mg/L	calculated TDS in applied LAD (mixed waters), 30% evaporation applied
volume of LAD Storage Pond liner leakage, **V_1**	27 ft^3/d	0.14 gpm	KP 2000c Apdx K, Tables
EC in LAD Storage Pond liner leakage discharge (mixed waters), **C_1**	886 µmhos	568 mg/L	EC calculated from TDS ;
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables

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length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of Aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_3}$=kiA, ground water available for mixing downgradient of Mason Ditch	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of flow in Mason Ditch assumed to infiltrate to ground water, $\mathbf{V_3}$	43,200 ft^3/d	224 gpm	KP 2000c Apdx K, Tables
assume TDS in Mason Ditch equivalent to median TDS concentration at EBR-007, $\mathbf{C_3}$	421 μmhos/cm	**270** mg/L	EBR-007, 270 mg/L; SMC Monitoring Data
CLOSURE *Boe Ranch LAD* Daily salt load	**5,063** lbs/day	**607,535** lbs/yr	**CLOSURE *Boe Ranch LAD* Total Salt Load (120 days)**
CLOSURE *Boe Ranch LAD* Ground Water Salinity Calculations			**Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch. The ground water at Boe Ranch has a Class II Beneficial Use.**
ground water EC from Boe Ranch LAD storage pond liner leakage	1,073 μmhos/cm	688 mg/L	TDS value calculated from EC
ground water EC beneath LAD area from liner leakage & applied LAD	1,263 μmhos/cm	810 mg/L	TDS value calculated from EC
ground water EC at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	1,012 μmhos/cm	649 mg/L	TDS value calculated from EC
EC in ground water downgradient of Mason Ditch, $\mathbf{C_d}$	**1,014** μmhos/cm	650 mg/L	TDS value calculated from EC; projected concentration in ground water just prior to discharge to East Boulder River above EBR-008
CLOSURE *Boe Ranch LAD* The EC of ground water below the Boe Ranch LAD is less than 1,000 μmhos/cm and meets the Class I Beneficial Use Criterion.			
CLOSURE *Boe Ranch LAD* East Boulder River Salinity Calculations			**Up to 164 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 100 MG treated adit water and land applied at Boe Ranch. The ground water at Boe Ranch has a Class II Beneficial Use.**
receiving streamflow, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder River streamflow during irrigation season at EBR-008 (CES 2008)
receiving stream ambient concentration, $\mathbf{C_s}$	421 μmhos/cm	**270** mg/L	median value, SMC monitoring data 2000-2004 at EBR-007
discharge volume, $\mathbf{Q_d}$	146,652 ft^3/d	1.7 cfs	ground water discharge volume in cubic feet per second
EC in ground water below Mason Ditch, $\mathbf{C_d}$	1,014 μmhos/cm	649 mg/L	
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration area during the irrigation season (2.0 cfs)	693 μmhos/cm	**444 mg/L**	projected salt concentration in the East Boulder River at EBR-008
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration at 7Q10 flow (5.0 cfs)	571 μmhos/cm	**366 mg/L**	projected salt concentration in the East Boulder River at EBR-008

CLOSURE *Boe Ranch LAD* Land application disposal of 743 gpm (24 hr) Boe Ranch LAD storage pond waters would produce an increased TDS concentration in the East Boulder River above the ambient TDS concentration of 340 mg/L at EBR-008. Given the median TDS concentration of the East Boulder River and of adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River downstream of the Boe Ranch. The ambient concentration is above the recommended TDS concentration of 250 mg/L to protect trout eggs.

Alternative 2C Salts CLOSURE Option 1, 150 gpm: Days 1-120 Up to 150 gpm (24 hr) adit water would be mixed and treated with 286 gpm tailings waters and routed to the Boe Ranch LAD storage pond. The 436 gpm (24 hr) mixed, treated adit and tailings waters would mix with 52 MG of treated stored water in the LAD storage pond, then land applied at Boe Ranch LAD at agronomic rates 743 gpm (24 hr rate). Days 121-365 During the rest of the 12-month closure period, the 150 gpm (24 hr) would be routed to the East Boulder Mine percolation pond.

858 µmhos/cm	550 mg/L	2000-2008 median adit TDS concentration; SMC Monitoring Data
1,399 µmhos/cm	897 mg/L	2000-2008 median tailings waters concentration, SMC Monitoring Data
1,213 µmhos/cm	778 mg/L	weighted average concentration of adit plus tailings waters; assume instantaneous mixing of mine waters

CLOSURE *Boe Ranch LAD* Hydraulic Loading Input Parameters, Days 1-120

assume Boe Ranch LAD storage pond contains 52 MG at the first day of closure

area available for LAD in section 17, all ten pivots	194 ac	7.7 gpm/ac	proposed agronomic land application rate (KP 2000C)
capacity to dispose of all treated mine waters during 120 day LAD season	743 gpm (24 hr)	**1,486** gpm (12 hr)	total capacity to dispose of all treated mine waters during 120 day LAD season
adit flow rate at closure	**150** gpm (24 hr)	300 gpm (12 hr)	adit flow rate
assumed volume in LAD storage pond	52 MG	40 MG	volume of East Boulder Tailings impoundment waters needing disposal
length of LAD season	120 days	602 gpm (12 hr)	rate to dewater LAD storage pond in 120 days
pumping rate to empty LAD storage pond in 120 days	**301** gpm (24 hr)	97 days	number of days to dewater East Boulder tailings impoundment
rate to dewater East Boulder tailings impoundment	**286** gpm (24 hr)	**1,474** gpm (12 hr)	total volume of water to be applied at Boe Ranch LAD

CLOSURE *Boe Ranch LAD* Days 1-120: The hydraulic load of 150 gpm (24 hr) treated adit water plus 286 gpm (24 hr) treated tailings waters and 301 gpm (24 hr) Boe Ranch LAD stored waters can be managed at Boe Ranch LAD in one 120 day LAD season without managing any waters at the East Boulder Mine. Days 121-365: The hydraulic load of 150 gpm (24 hr) treated adit water can be managed at the East Boulder Mine percolation pond.

CLOSURE *Boe Ranch LAD* Days 1-120: Salinity Calculations

Up to 436 gpm (24 hr) mixed treated adit and tailings waters would be mixed in the Boe Ranch LAD storage pond containing 52 MG treated adit water and land applied at Boe Ranch. The ground water at Boe Ranch has a Class II Beneficial Use.

depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of source (LAD storage pond liner leakage)	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone, $\mathbf{W_1}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length, $\mathbf{L_1}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer, $\mathbf{A_1}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
ground water available for mixing at liner leakage, $\mathbf{Q_1}$=kiA	97 ft^3/d		KP 2000c Apdx K, Tables
EC of ambient ground water; median value from RMW-3a, $\mathbf{C_A}$	721 mg/L	1,125 µmhos	EC calculated from RMW-3 median TDS value at Boe Ranch proposed LAD area; 2000-2005 SMC Monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application,$\mathbf{L_2}$	4,500 ft		KP 2000c Apdx K, Tables
width of mixing zone, $\mathbf{W_2}$	3,593 ft		allowed by 17.30.517(d)
cross sectional area of aquifer, $\mathbf{A_2}$	53,901 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_2}$=kiA, ground water available for mixing	1,525 ft^3/d	737 gpm (24 hr)	volume of applied treated mine waters during 120 day LAD season

volume of applied LAD, 30% evaporation applied, V_2	99,308 ft^3/d	**668** mg/L	weighted TDS concentration of mixed adit, tailings, and stored waters in LAD storage pond
calculated EC in applied LAD (mixed waters); evaporation applied, C_2	1,488 µmhos/cm	954 mg/L	calculated TDS in applied LAD (mixed waters), 30% evaporation applied
volume of LAD Storage Pond liner leakage, V_1	27 ft^3/d	0.14 gpm	KP 2000c Apdx K, Tables
EC in LAD Storage Pond liner leakage discharge (mixed waters), C_1	1,042 µmhos/cm	668 mg/L	EC calculated from TDS ;
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, L_3	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of Aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, ground water available for mixing downgradient of Mason Ditch	1,674 ft^3/d		allowed by 17.30.517(d)
25% of total volume of flow in Mason Ditch assumed to infiltrate to ground water, V_3	43,200 ft^3/d	224 gpm	KP 2000c Apdx K, Tables
assume TDS in Mason Ditch equivalent to median TDS concentration at EBR-007, C_3	421.2 µmhos/cm	270 mg/L	median value, SMC monitoring data 2000-2004 at EBR-007
ground water EC from Boe Ranch LAD storage pond liner leakage	1,107 µmhos/cm	709 mg/L	TDS value calculated from EC
ground water EC beneath LAD area from liner leakage & applied LAD	1,482 µmhos/cm	950 mg/L	TDS value calculated from EC
ground water EC at Mason Ditch from LAD storage pond liner leakage, applied LAD, and Mason Ditch infiltration	1,164 µmhos/cm	746 mg/L	TDS value calculated from EC
EC in ground water Days 1-120 downgradient of Mason Ditch, C_d	**1,164** µmhos/cm	746 mg/L	TDS value calculated from EC; projected concentration in ground water just prior to discharge to East Boulder River above EBR-008

CLOSURE *Boe Ranch LAD* The EC of ground water is less than the 2,500 µmhos/cm Class II Beneficial Use Criterion.

receiving streamflow (2.0 cfs), Q_s	172,800 ft^3/d	2.0 cfs	value for East Boulder River streamflow during irrigation season at EBR-008 (CES
receiving streamflow (5.0 cfs), Q_s	432,000 ft^3/d	5.0 cfs	7Q10 streamflow at East Boulder Mine MPDES Permit Statement of Basis
receiving stream ambient concentration, C_s	421 µmhos/cm	270 mg/L	median value, SMC monitoring data 2000-2004 at EBR-007
discharge volume, Q_d	145,831 ft^3/d	1.7 cfs	
EC in ground water below Mason Ditch, C_d	1,164 µmhos/cm	746 mg/L	
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration Days 1-120 (2.0 cfs)	761 µmhos/cm	**488 mg/L**	projected salt concentration in the East Boulder River at EBR-008 during irrigation withdrawals; **an increase of 44% above ambient TDS**
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration at 7Q10 flows Days 1-120 (2.0 cfs)	609 µmhos/cm	**390 mg/L**	projected salt concentration in the East Boulder River at EBR-008 at 7Q10 flows; **an increase of 15% above ambient TDS**

CLOSURE *Boe Ranch LAD* Land application disposal of 743 gpm (24 hr) Boe Ranch LAD storage pond waters would produce an increased TDS concentration in the East Boulder River above the ambient TDS concentration of 340 mg/L at EBR-008. Given the median TDS concentration of adit water, no volume of adit water can be land applied at a rate that would reduce the TDS concentration in the East Boulder River below Boe Ranch. The ambient concentration is above the recommended TDS concentration of 250 mg/L to protect fish eggs.

CLOSURE *East Boulder Mine* Days 121-365: Salinity Calculations

Days 121-365: Up to 150 gpm treated adit waters would be disposed the East Boulder Mine percolation pond.

East Boulder Mine Source-Specific percolation pond mixing zone imputs

		550 mg/L	2000-2008 median adit TDS concentration; SMC Monitoring Data
depth of aquifer, **D**	80 ft		MPDES Permit Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Permit Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Permit Statement of Basis, p. 25-26

width of source	385 ft			MPDES Permit Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3,600 ft			MPDES Permit Statement of Basis, p. 25-26
porosity, ϕ	0.3			MPDES Permit Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d			MPDES Permit Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400 gpm			MPDES Permit Statement of Basis, p. 25-26
upgradient concentration of TDS in ground water (at WW-1), $\mathbf{C_A}$	97 mg/L	151	μmhos/cm	1989-2009 SMC Monitoring Data median value
angle of dispersion	0.087421693 tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977 ft^2			D * W, allowed by 17.30.517(d)
70% Volume of aquifer available for mixing $\mathbf{Q_1}$=kiA_1	109,156 ft^3/d			MPDES Permit Statement of Basis, p. 25-26
Volume of adit water percolated days 1-120, $\mathbf{V_p}$	0 ft^3/d	**0**	gpm (24 hr)	treated adit & tailings waters disposed at East Boulder Mine percolation pond days 1-120
depth of aquifer MPDES Statement of Basis, p. 25-26, $\mathbf{D_2}$	15 ft	**150**	gpm (24 hr)	treated adit water disposed at East Boulder Mine percolation pond days 121-365
hydraulic conductivity MPDES Statement of Basis, p. 25-26, **k**	75 ft/d	28,877	ft^3/d	Volume of adit water percolated days 121-365, $\mathbf{V_p}$
gradient, **i**	0.026 ft/ft			MPDES Permit Statement of Basis, p. 25-26
width of source	700 ft			MPDES Permit Statement of Basis, p. 25-26
length from percolation pond to river, $\mathbf{L_2}$	2,900 ft			MPDES Permit Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2			D * W, allowed by 17.30.517(d)
Volume of aquifer available for mixing below tailings impoundment $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
median TDS concentration of adit water, $\mathbf{C_P}$	550 mg/L	858	μmhos/cm	median EC of adit water
receiving stream ambient concentration at EBR-001, $\mathbf{Q_c}$	45 mg/L	76	μmhos/cm	1989-2009 SMC Monitoring Data median value
receiving streamflow, $\mathbf{Q_s}$	423,000 ft^3/d	5	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4
effective calculated EC in applied waters LAD Area 6; assume pivots 30% evaporation, $\mathbf{C_2}$	786 mg/L	0	gpm (24 hr)	rate of land application at East Boulder Mine LAD Area 6 (full capacity)
volume of applied LAD evaporation credit taken, $\mathbf{V_2}$	0 ft^3/d	**Up to 150 gpm treated adit water would be disposed at the East Boulder Mine percolation pond.**		
CLOSURE *East Boulder Mine* Days 121-365: Salt concentration in ground water	229 mg/L	**358**	μmhos/cm	projected salt concentration in ground water at SP-11
CLOSURE *East Boulder Mine* Days 121-365 Salt concentration in East Boulder River below East Boulder Mine	**97** mg/L	151	μmhos/cm	projected salt concentration in the East Boulder River at EBR-004A

CLOSURE *East Boulder Mine* : The EC of ground water at East Boulder Mine would be less than the Class I Beneficial Use Criterion of 1,000 μmhos/cm. The TDS concentration in the East Boulder River at the East Boulder Mine would be less than the 250 mg/L recommendation to protect trout eggs.

Spreadsheet 3C Nitrogen--Agency-Mitigated Alternative 3C Boe Ranch LAD System Operations and Closure Nitrogen Analyses

If the Boe Ranch LAD was constructed it would be the agencies' preferred disposal option for treated adit water during operations and for treated adit plus tailings waters during the first eighteen months of closure. The East Boulder Mine LAD facilities would first be used for contingency disposal of treated adit water during operations, then the percolation pond. Monitoring well RMW-3A is located at Boe Ranch downgradient of the proposed LAD area and is considered to represent ambient total inorganic nitrogen (TIN) values. Baseline concentrations of TIN in the East Boulder River average 0.1 mg/L. At closure, all adit and East Boulder tailings waters would be treated through the BTS/Anox system then routed to the Boe Ranch LAD storage pond all year and disposed of through LAD pivots during the summer LAD season. For the Boe Ranch LAD, calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Boe Ranch LAD area any water that percolates below the root zone is assumed to immediately enter the ground water.

The Boe Ranch LAD area would not have an MPDES permit. The BTS/Anox would be the same as Alternative 2B, with treated water routed to Boe Ranch LAD during operations and 18 months of closure. For this analysis, 20% of the applied TIN concentrations are expected to flush through the soil column/unsaturated zone to ground water at some point during the year. Ground water beneath the LAD area and LAD storage pond flows down-gradient where it is recharged by the Mason Ditch, then discharges to the East Boulder River. These calculations assume that during operations treated adit waters are routed to the Boe Ranch LAD storage pond. During summer LAD, PoleCat evaporators accomplish 30% evaporation and the center pivots accomplish 30% evaporation. In the winter, PoleCat snowmaking accomplishes 30% evaporation up slope of the lined LAD storage pond. At closure, treated adit and tailings waters would be routed to the Boe Ranch LAD storage pond which would hold 100 MG of adit water, and mixing of these waters would occur prior to disposal at the LAD pivots. A weighted average was used to determine the concentration of TIN in the mixed LAD storage pond water. The East Boulder Mine MPDES permit has a

monthly average TIN limit of 30 lbs/day. Historical maximum TIN load after BTS/Anox system treatment of 20 lbs/day was used in this analysis. These calculations assume that there will be a leak in the Boe Ranch LAD storage pond, and the liner leakage, land-applied water, and Mason Ditch waters contribute to ground water quality prior to discharge into the East Boulder River. It is assumed that only nine of the proposed Boe Ranch LAD center pivots on 166 of the proposed 194 acres in Section 17 will be developed for use during operations and closure. Fifty percent of proposed pivots 4 and 9 would be used, and none of pivot 10 would be used to prevent potential mass wasting/ stability problems. The TIN concentration of treated discharge will vary with total flow rate.

OPERATIONS CALCULATIONS

Alternative 3C Nitrogen Operations Option 1, 737 gpm: SMC would route 284 gpm treated adit water to the Boe Ranch LAD storage pond during the entire year. Treated adit water stored in the Boe Ranch LAD storage pond over fall, winter, and early spring, would be disposed of during the Boe Ranch LAD season. During the 120-day LAD season the 284 gpm treated adit water would be disposed of with up to 579 gpm stored treated adit water on the 166-acre Boe Ranch LAD area at greater than agronomic rates (10.4 gpm/acre). The excess 453 gpm of treated adit water would be disposed of at the East Boulder Mine during the entire year. During the LAD season at the mine, 293 gpm would be land applied at the East Boulder Mine LAD Area 6 and 160 gpm routed to the East Boulder Mine percolation pond. During snowmaking season, 205 gpm could be disposed of at the East Boulder Mine LAD Area 6 and 248 gpm at the percolation pond. The rest of the year, 453 gpm treated adit water would be disposed of at the East Boulder Mine percolation pond.

treated total inorganic nitrogen concentration of adit waters based on historical BTS/Anox system treatment and flow rate	2.3	mg/L	**20**	pound/day	historical maximum post BTS/Anox system total inorganic nitrogen load at East Boulder Mine
OPERATIONS Hydraulic Loading Calculations	**assume 120 day LAD season and that Boe Ranch LAD storage pond contains 100 MG from previous winter**				
length of LAD season	120	days	863	gpm (24 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, in Section 17
area available for LAD in section 17, **9 pivots** included (prevent mass wasting issues)	166	ac	**1,726**	gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, using 9 pivots in Section 17
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4	gpm/ac	569	gpm (12 hr)	**LAD capacity available** at Boe Ranch LAD **for adit water** after dewatering Boe Ranch LAD storage pond
assumed volume in Boe Ranch LAD storage pond	100	MG	**1,157**	gpm (12 hr)	rate to dewater Boe Ranch LAD storage pond in one 120-day LAD season
adit flow rate during operations	**737**	gpm (24 hr)	1,474	gpm (12 hr)	adit flow rate during operations
adit flow rate that must be **managed at East Boulder Mine**	**453**	gpm (24 hr)	905	gpm (12 hr)	**adit** flow rate that must be **managed at East Boulder Mine**
summer hydraulic capacity available at East Boulder Mine at **LAD Area 6**	293	gpm (24 hr)	115	days	time to fill Boe Ranch LAD storage pond with adit water after 120 day LAD season
winter hydraulic capacity available at East Boulder Mine at **LAD Area 6**	205	gpm (24 hr)	1,105	gpm (24 hr)	capacity of East Boulder Mine percolation pond (MPDES permit Statement of Basis)
summer excess adit flow rate that must be **percolated** at East Boulder Mine	**160**	gpm (24 hr)	**248**	gpm (24 hr)	**winter** excess adit flow rate that must be **percolated** at East Boulder Mine

volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	569 gpm (12 hr)	volume of water routed to **Boe Ranch LAD year round**

During the 120 day LAD season, the hydraulic load of 284 gpm treated adit water plus 579 gpm treated stored water can be managed at Boe Ranch LAD area if seven pivots are operating at greater than agronomic rates as is done at the Hertzler Ranch LAD area. The excess water 453 gpm would be disposed at the East Boulder Mine LAD Area 6 and percolation pond.

OPERATIONS ***East Boulder Mine*** **Summer** nitrogen **percolated load**	**4.3** lbs/day	**160** gpm (24 hr)	adit water volume percolated at East Boulder Mine percolation pond in **summer**
OPERATIONS ***East Boulder Mine*** **Winter** nitrogen **percolated load**	**6.7** lbs/day	**248** gpm (24 hr)	adit water volume percolated at East Boulder Mine percolation pond in **winter**
OPERATIONS ***East Boulder Mine*** **Summer LAD Area 6** nitrogen **load**	1.6 lbs/day	**5.9** lbs/day	**OPERATIONS** ***East Boulder Mine*** **total percolation plus LAD load**
OPERATIONS ***East Boulder Mine*** **Winter LAD Area 6** nitrogen **load**	1.1 lbs/day	**7.8** lbs/day	**OPERATIONS** ***East Boulder Mine*** **total percolation plus snowmaking load**
OPERATIONS ***East Boulder Mine*** **adit percolated volume**	453 gpm (24 hr)	**12.3** lbs/day	**OPERATIONS** ***East Boulder Mine*** **percolation only load**

3C OPERATIONS The total inorganic nitrogen load produced at the East Boulder Mine in summer by LAD of 293 gpm (24 hr) and percolation of 160 gpm (24 hr) treated adit water does not exceed the MPDES limit of 30 lbs/day at the East Boulder Mine. The total inorganic nitrogen load produced at the East Boulder Mine in winter by LAD of 205 gpm (24 hr) and percolation of 248 gpm (24 hr) does not exceed the 30 lbs/day total inorganic nitrogen limit at the East Boulder Mine. The total inorganic nitrogen load produced at the East Boulder Mine from percolation of 453 gpm (24 hr) does not exceed the 30 lbs/day total inorganic nitrogen limit.

OPERATIONS ***Boe Ranch LAD*** **Nitrogen Loading Calculations**		**Disposal of 1,726 gpm (12 hr) at higher than agronomic rates at the Boe Ranch LAD area over a 120-day LAD season**	
length of LAD season	120 days	**737** gpm (24 hr)	adit flow rate at closure
historical maximum post BTS/Anox system total inorganic nitrogen load	20 lbs/day	**2.3** mg/L	treated total inorganic nitrogen concentration of adit waters
land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4 gpm/ac	**1,726** gpm (12 hr)	daily hydraulic load that can be applied on 166 acres, all Section 17 pivots
depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone for the LAD storage pond liner leakage, W_2	229 ft		width of source + (tan 5 * length) allowed by statute 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_2	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_2	3,428 ft^2		D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27 ft^3/d		KP 2000c Apdx K, Tables
Q_2=kiA, **ground water** available for mixing below **liner leakage**	97 ft^3/d		
concentration of **total inorganic nitrogen in ambient ground water**; median value from RMW-3a, C_A	0.1 mg/L		median ambient total inorganic nitrogen concentration derived from SMC monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, L_1	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, W_1	3,593 ft		allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, A_1	53,901 ft^2		D * W, allowed by 17.30.517(d)

Q_1=kiA, **ground water** available for mixing below **LAD application area**	1,525 ft^3/d		allowed by 17.30.517(d)
volume of LAD applied; evaporation factor taken, V_1	116,324 ft^3/d	1,208 gpm (12 hr)	adit water applied; evaporation credit taken
total inorganic nitrogen concentration in applied LAD adit water; assume 80% post plant TIN uptake, C_1	0.6 mg/L	0.14 gpm (24 hr)	estimate of LAD storage pond liner leakage, used by Hydrometrics (KP 2000c)
total inorganic nitrogen in LAD storage **pond liner leakage** discharge, C_2	2.3 mg/L		treated total inorganic nitrogen concentration of adit waters
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, L_3	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d		allowed by 17.30.517(d)
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,123 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **total inorganic nitrogen concentration of Mason Ditch**, C_3	0.1 mg/L		assumed equivalent to the average of EBR-007and EBR-008
total inorganic nitrogen concentration in ground water resultotal inorganic nitrogeng from applied LAD	**2.2** mg/L	**737** gpm (24 hr)	projected total inorganic nitrogen concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational total inorganic nitrogen concentration** in ground water for Q_1
total inorganic nitrogen concentration in ground water resultotal inorganic nitrogeng from liner leakage plus applied LAD	**2.2** mg/L		projected cumulative total inorganic nitrogen concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational total inorganic nitrogen concentration** in ground water for Q_2
total inorganic nitrogen concentration in ground water at Mason Ditch resultotal inorganic nitrogeng from liner leakage, applied LAD, and Mason Ditch	**1.6** mg/L		projected cumulative total inorganic nitrogen concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration** of total inorganic nitrogen in ground water below the Mason Ditch to the East Boulder River
OPERATIONS total inorganic nitrogen concentration in ground water down-gradient of Mason Ditch, C_d	**1.6** mg/L		compliance point in ground water; projected cumulative total inorganic nitrogen concentration prior to discharge to the East Boulder River

OPERATIONS The concentration of nitrogen in ground water below the Boe Ranch LAD area from the disposal of 1, 726 gpm treated adit water at greater than agronomic rates is projected to be less than the DEQ-7 ground water standard of 10 mg/L total inorganic nitrogen.

receiving streamflow, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow, non-irrigation season
receiving streamflow, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow, irrigation season
receiving stream ambient concentration, C_s	0.1 mg/L		KP 2000c, SMC Monitoring Data
ground water discharge volume, Q_d	162,771 ft^3/d	1.9 cfs	ground water discharge volume in cubic feet per second
ground water concentration below Mason Ditch, C_d	1.6 mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
OPERATIONS East Boulder River total inorganic nitrogen concentration **below Boe Ranch LAD at 5 cfs**	**0.5** mg/L		projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
OPERATIONS East Boulder River total inorganic nitrogen concentration **below Boe Ranch LAD at 2 cfs**	**0.8** mg/L		projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals

OPERATIONS The total inorganic nitrogen concentration in the East Boulder River below the Boe Ranch LAD Area at EBR-008 from the disposal of 1,726 gpm treated adit water is projected to be less than 1.0 mg/L.

Alternative 3C total inorganic nitrogen OPERATIONS Option 1, 150 gpm: SMC would route 150 gpm (24 hr) treated adit water to the Boe Ranch LAD storage pond all year. The 150 gpm (24 hr) of treated adit water and 301 gpm (24 hr) of stored treated adit water would be disposed at Boe Ranch LAD at greater than agronomic rates during the 120-day LAD season. No treated adit water disposal would occur at the East Boulder Mine.

Assume the BTS/Anox capacity is 1,000 gpm for 24 hours

Boe Ranch LAD design capacity is 1,486 gpm for 12 hr rate (743 gpm for 24 hr rate)

assume 120 day LAD season and that Boe Ranch LAD storage pond contains 52 MG from previous winter

OPERATIONS *Boe Ranch LAD* Hydraulic Loading

			100	MG	capacity of Boe Ranch LAD storage pond
volume in Boe Ranch LAD storage pond; assume 8 months storage of adit water	52	MG	120	days	time to dewater Boe Ranch LAD storage pond in one season
area available for LAD in section 17, all pivots included	166	ac	602	gpm (12 hr)	rate to dewater Boe Ranch LAD storage pond in one season
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4	gpm/ac	**1,726**	gpm (12 hr)	hydraulic load that can be applied on 166 acres, 9 pivots in Section 17
adit flow rate at closure	**150**	gpm (24 hr)	**902**	gpm (12 hr)	rate of LAD to dispose of adit plus stored water

OPERATIONS *Boe Ranch LAD* During the 120 day LAD season, the (24 hr) hydraulic load of 150 gpm adit water plus 602 gpm (12 hr) rate to dewater stored water in the Boe Ranch LAD storage pond (52 MG) can be managed at Boe Ranch LAD area if 9 pivots are operating on 166 acres at greater than agronomic rates, as is done at Hertzler Ranch LAD.

OPERATIONS *Boe Ranch LAD* Nitrogen Loading Calculations

			150	gpm (24 hr)	adit flow rate
			20	lbs/day	historical maximum post BTS/Anox total inorganic nitrogen load
			11.1	mg/L	treated conc of adit waters based on historical max concentration
			902	gpm (12 hr)	hydraulic load to be applied on 166 acres, 9 Section 17 pivots
depth of aquifer, **D**	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283	ft/d			estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10	ft			assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone for the LAD storage pond liner leakage, W_2	229	ft			width of source + (tan 5 * length) allowed by statute 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_2	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_2	3,428	ft^2			D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27	ft^3/d	0.14	gpm (24 hr)	KP 2000c Apdx K, Tables
Q_2=kiA, **ground water** available for mixing below **liner leakage**	97	ft^3/d			
concentration of **total inorganic nitrogen in ambient ground water**; median value from RMW-3a, C_A	0.1	mg/L			median total inorganic nitrogen concentration at RMW-3a derived from SMC monitoring data
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, L_1	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, W_1	3,593	ft			allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, A_1	53,901	ft^2			D * W, allowed by 17.30.517(d)
Q_1=kiA, **ground water** available for mixing below **LAD application area**	1,525	ft^3/d			allowed by 17.30.517(d)
volume of LAD applied; evaporation factor taken, V_1	121,533	ft^3/d	**631**	gpm (24 hr)	evaporation factor applied to hydraulic load to be applied on 166 acres, 9 Section 17 pivots

total inorganic nitrogen concentration in applied LAD adit water; assume 80% post plant total inorganic nitrogen uptake, $\mathbf{C_1}$	3.2 mg/L	150 gpm (24 hr)	adit water; no evaporation credit taken
total inorganic nitrogen in LAD storage **pond liner leakage** discharge, $\mathbf{C_2}$	11.1 mg/L		
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		KP 2000c Apdx K, Tables
cross sectional area of aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		width of source + (tan 5 * length) allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d		D * W, allowed by 17.30.517(d)
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), $\mathbf{V_3}$	43,123 ft^3/d	224 gpm (24 hr)	25% of total volume of Mason Ditch; KP 2000c Apdx K, Tables
assumed **total inorganic nitrogen concentration of Mason Ditch**, $\mathbf{C_3}$	0.1 mg/L		assumed equivalent to the average of EBR-007and EBR-008
total inorganic nitrogen concentration in ground water resultotal inorganic nitrogeng from applied LAD	**3.1** mg/L	**150** gpm (24 hr)	projected total inorganic nitrogen concentration in ground water below the Boe Ranch LAD storage pond; this value will be assumed to equal the operational concentration of total inorganic nitrogen in ground water below the Boe Ranch LAD storage pond
total inorganic nitrogen concentration in ground water resulting from liner leakage plus applied LAD	**3.1** mg/L		projected total inorganic nitrogen concentration in ground water below the Boe Ranch LAD area; assumed to equal the operational total inorganic nitrogen concentration in ground water for Q1
total inorganic nitrogen concentration in ground water at Mason Ditch resulting from liner leakage, applied LAD, and Mason Ditch	**2.3** mg/L		projected cumulative total inorganic nitrogen concentration in ground water beneath the Mason Ditch; this value will be assumed to equal the operational concentration of total inorganic nitrogen in ground water at the Mason Ditch
OPERATIONS total inorganic nitrogen concentration in ground water down-gradient of Mason Ditch, $\mathbf{C_d}$	**2.3** mg/L		compliance point in ground water; projected cumulative total inorganic nitrogen concentration prior to discharge to the East Boulder River; this value will be assumed to equal the operational concentration of total inorganic nitrogen in ground water below the Mason Ditch to the East Boulder River

OPERATIONS The concentration of nitrogen in ground water below the Boe Ranch LAD area from the disposal of 902 gpm treated adit water at greater than agronomic rates is projected to be less than the DEQ-7 ground water standard of 10 mg/L total inorganic nitrogen.

receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow, non-irrigation season
receiving streamflow, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow, irrigation season
receiving stream ambient concentration, $\mathbf{C_s}$	0.1 mg/L		KP 2000 Appx K
ground water discharge volume, $\mathbf{Q_d}$	167,979 ft^3/d	1.9 cfs	ground water discharge volume in cubic feet per second
ground water concentration below Mason Ditch, $\mathbf{C_d}$	2.3 mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
East Boulder River below Boe Ranch total inorganic nitrogen concentration 5.0 cfs, non-irrigation season	**0.7** mg/L		projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
East Boulder River below Boe Ranch total inorganic nitrogen concentration 2.0 cfs, irrigation season	**1.2** mg/L		projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals

OPERATIONS The nitrogen concentration in the East Boulder River below the Boe Ranch LAD Area at EBR-008 from the disposal of 902 gpm treated adit water is projected to be less than 1.0 mg/L when East Boulder River flow is greater than 3 cfs. The projected concentration of nitrogen in the East Boulder River would be greater than 1 mg/L total inorganic nitrogen when the East Boulder River flow is 2 cfs.

CLOSURE CALCULATIONS

Agency-Mitigated Alternative 3C CLOSURE Option 1, 737 gpm: At closure, SMC would treat 737 gpm adit water and 263 gpm tailings waters in the BTS. The closure time frame would be 18 months. *Days 1-120:* SMC would maximize disposal of 284 gpm treated adit and tailings waters at the Boe Ranch LAD area at greater than agronomic rates. SMC would dispose of the remaining 716 gpm at the East Boulder Mine. LAD Area 6 would receive 293 gpm and the excess 423 gpm would be routed to the East Boulder Mine percolation pond during the first 120 day summer LAD season in the 18 month closure period.

***Days 121-365:* After day 120, the tailings impoundment would be closed and only 737 gpm of treated adit water would need disposal during the rest of the 18-month closure period. From days 121-365, up to 284 gpm would be routed to the Boe Ranch LAD storage pond, and 453 gpm would be disposed at the East Boulder MIne percolation pond.**

***Days 366-548:* During the second year 120 day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters in the Boe Ranch LAD storage pond. After the second year LAD season, all 737 gpm of treated adit water would be disposed at the East Boulder Mine percolation pond.**

CLOSURE *Boe Ranch LAD* hydraulic loading *Days 1-120*		***Days 1-120:* Disposal of 284 gpm treated adit and tailings waters with 579 gpm stored treated adit water at the Boe Ranch LAD; disposal of 293 at the East Boulder Mine LAD Area 6, and 423 gpm at the percolation pond; no winter LAD disposal would occur at East Boulder Mine**		
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4 gpm/ac	**1,726**	gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, using 9 pivots in Section 17
assumed Boe Ranch **LAD storage pond volume**	100 MG	40	MG	East Boulder **tailings waters volume**
rate to dewater Boe Ranch LAD storage pond in one season	**579** gpm (24 hr)	1,157	gpm (12 hr)	rate to **dewater Boe Ranch LAD storage pond** in one season
adit flow rate during closure	**737** gpm (24 hr)	1,474	gpm (12 hr)	**adit flow rate** during closure
rate to dewater **East Boulder tailings impoundment**	**263** gpm (24 hr)	569	gpm (12 hr)	**LAD capacity available** at Boe Ranch LAD **for adit water** after dewatering Boe Ranch LAD storage pond
time to dewater the East Boulder tailings impoundment	106 days	**716**	gpm (24 hr)	**excess** water that must be **managed at East Boulder Mine**
hydraulic capacity available at East Boulder Mine at **LAD Area 6**	**293** gpm (24 hr)	1,105	gpm (24 hr)	capacity of East Boulder Mine percolation pond (MPDES permit Statement of Basis)
excess adit and tailings waters that must be **percolated** at East Boulder Mine	**423** gpm (24 hr)	**284**	gpm (24 hr)	volume of water routed to **Boe Ranch LAD year round**
CLOSURE *Boe Ranch LAD* hydraulic loading *Days 121-365*		***Days 121-365:* Of the 737 gpm treated adit water, 284 gpm would be routed to the Boe Ranch LAD storage pond and 453 gpm would be routed to the East Boulder Mine percolation pond**		
volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	**453**	gpm (24 hr)	excess adit waters that must be **percolated** at East Boulder Mine
CLOSURE *Boe Ranch LAD* hydraulic loading *Days 366-486*		***Days 366-486:* Second 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. Excess waters would be percolated at the East Boulder Mine percolation pond.**		
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4 gpm/ac	**1,726**	gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, using 9 pivots in Section 17
assumed Boe Ranch **LAD storage pond volume**	100 MG	0	MG	East Boulder **tailings waters volume**
rate to dewater Boe Ranch LAD storage pond in one season	579 gpm (24 hr)	1,157	gpm (12 hr)	rate to **dewater Boe Ranch LAD storage pond** in one season
volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	**453**	gpm (24 hr)	excess treated adit water that must be **percolated** at East Boulder Mine
CLOSURE *Boe Ranch LAD* hydraulic loading *Days 487-548*		***Days 487-548:* After the second LAD season, all 737 gpm treated adit water would be routed to the East Boulder Mine percolation pond**		
treated adit water that must be **percolated** at East Boulder Mine	**737** gpm (24 hr)	0	MG	East Boulder **tailings waters volume**

The hydraulic load of 737 gpm plus 263 gpm tailings waters can be managed at the East Boulder Mine and the Boe Ranch LAD area under Option 1, 737 gpm.

CLOSURE *East Boulder Mine* nitrogen loading Days 1-120			***Days 1-120:* Disposal of 293 gpm treated adit and tailings waters at the East Boulder Mine LAD Area 6, and 423 gpm treated adit and tailings waters at the percolation pond; no winter LAD disposal would occur at East Boulder Mine**		
Days 1-120 total inorganic nitrogen load at LAD Area 6	**3.0**	lbs/day	**2.3**	mg/L	total inorganic nitrogen concentration of treated adit water
Days 1-120 percolation total inorganic nitrogen load at East Boulder Mine	**21.8**	lbs/day	**10**	mg/L	total inorganic nitrogen concentration of treated tailings waters based on 80% nitrogen removal by BTS/Anox system
Days 1-120 LAD Area 6 plus percolation total inorganic nitrogen load at East Boulder Mine	**24.8**	pound/day	**4.3**	mg/L	total inorganic nitrogen concentration of mixed treated adit plus tailings waters (weighted average)

CLOSURE Days 1-120 *East Boulder Mine:* The nitrogen load from disposal of 293 gpm treated adit and tailings waters at the LAD Area 6 and percolation of 423 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day MPDES permit limit.

CLOSURE *Boe Ranch LAD* nitrogen loading Days 1-120			***Days 1-120:* Disposal of 284 gpm treated adit and tailings waters with 579 gpm stored treated adit water at the Boe Ranch LAD so storage pond would be emptied by the end of the 120-day LAD season; excess waters would be disposed at the East Boulder Mine**		
volume of water applied at **Boe Ranch LAD**	**863**	gpm (24 hr)	**737**	gpm (24 hr)	adit flow rate at closure
depth of aquifer, **D**	15	ft			allowed by statute 17.30.517(d)
hydraulic conductivity, **k**	0.283	ft/d			estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10	ft			assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone for the LAD storage pond liner leakage, $\mathbf{W_2}$	229	ft			width of source + (tan 5 * length) allowed by statute 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by statute 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_2}$	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_2}$	3,428	ft^2			D * W, allowed by statute 17.30.517(d)
volume of LAD storage pond **liner leakage**, $\mathbf{V_2}$	27	ft^3/d	0.14	gpm (24 hr)	KP 2000c Apdx K, Tables
$\mathbf{Q_2}$=kiA, **ground water** available for mixing below **liner leakage**	97	mg/L	**2.2**	mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in $\mathbf{Q_2}$
concentration of **total inorganic nitrogen in ambient ground water**; median value from RMW-3a, $\mathbf{C_A}$	0.1				at closure, this concentration is assumed to be present only in ground water entering the LAD
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_1}$	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, $\mathbf{W_1}$	3,593	ft			allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, $\mathbf{A_1}$	53,901	ft^2			D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, **ground water** available for mixing below **LAD application area**	1,525	ft^3/d	**2.2**	mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in $\mathbf{Q_1}$
volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	116,324	ft^3/d	**1,208**	gpm (12 hr)	evaporation factor applied to hydraulic load to be applied on 166 acres, 9 Section 17 pivots
total inorganic nitrogen concentration in applied LAD; assume 80% post plant total inorganic nitrogen uptake, $\mathbf{C_1}$	1.2	mg/L	2.3	mg/L	concentration of total inorganic nitrogen in Boe Ranch LAD storage pond at beginning of closure
total inorganic nitrogen in LAD storage **pond liner leakage** discharge, $\mathbf{C_2}$	2.9		2.9	mg/L	weighted average concentration of total inorganic nitrogen in Boe Ranch LAD storage pond after mixing with tailings waters
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593	ft			KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000	ft			KP 2000c Apdx K, Tables

width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by statute 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		D * W, allowed by statute 17.30.517(d)
$\mathbf{Q_3}$=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	**1.6** mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in Q_3
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), $\mathbf{V_3}$	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **total inorganic nitrogen concentration of Mason Ditch**, $\mathbf{C_3}$	0.1 mg/L		assumed equivalent to the average of EBR-007and EBR-008
total inorganic nitrogen concentration in ground water resulting from **applied LAD**	1.2 mg/L		projected nitrogen concentration using operational ground water values
total inorganic nitrogen concentration in ground water resulting from **liner leakage plus applied LAD**	1.2 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
total inorganic nitrogen concentration in ground water at Mason Ditch resulting from **liner leakage, applied LAD, and Mason Ditch**	0.9 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
CLOSURE total inorganic nitrogen concentration in ground water **downgradient of Mason Ditch,** $\mathbf{C_d}$	**0.9** mg/L		projected cumulative nitrogen ground water concentration using operational ground water values

CLOSURE Days 1-120 ground water at the Boe Ranch LAD: The nitrogen concentration in ground water at the Boe Ranch LAD from the disposal of 1,726 gpm (12 hr) treated adit and tailings waters is projected to be less than the DEQ-7 ground water standard of 10 mg/L.

receiving streamflow, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow, non-irrigation season
receiving streamflow, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow, irrigation season
receiving stream ambient concentration, $\mathbf{C_s}$	0.1 mg/L		KP 2000 Appx K
ground water discharge volume, $\mathbf{Q_d}$	127,854 ft^3/d	1.5 cfs	ground water discharge volume in cubic feet per second
ground water concentration below Mason Ditch, $\mathbf{C_d}$	0.9 mg/L		projected total inorganic nitrogen concentration in ground water just prior to discharge to East Boulder River
CLOSURE East Boulder River total inorganic nitrogen concentration at **5 cfs flow**	**0.3** mg/L		projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
CLOSURE East Boulder River total inorganic nitrogen concentration at **2 cfs flow (irrigation season)**	**0.4** mg/L		projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals

CLOSURE ***Boe Ranch LAD*** **days 1-120*:* The nitrogen concentration in surface water downstream of the Boe Ranch LAD from the disposal of 1,726 gpm (12 hr) treated adit and tailings waters in the East Boulder River is projected to be less than 1.0 mg/L.**

CLOSURE ***East Boulder Mine*** **nitrogen loading calculations Days 121-365**

Days 121-365: **Of the 737 gpm treated adit water, 284 gpm would be routed to the Boe Ranch LAD storage pond and 453 gpm would be routed to the East Boulder Mine percolation pond**

CLOSURE Days 121-365 percolation total inorganic nitrogen load at East Boulder Mine	**12.3** lbs/day	**2.3** mg/L	total inorganic nitrogen concentration of treated adit water

CLOSURE ***East Boulder Mine*** **Days 121 -365: The nitrogen load from percolation of 453 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day MPDES permit limit.**

CLOSURE ***East Boulder Mine*** **nitrogen loading calculations Days 366-486**

Days 366-486: **Second 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. The 453 gpm of excess treated adit waters would be percolated at the East Boulder Mine percolation pond.**

total inorganic nitrogen concentration of treated adit water	**2.3** mg/L	**12.3** lbs/day	CLOSURE Days 366-486 percolation total inorganic nitrogen load at East Boulder Mine

CLOSURE Days 366-486 ***East Boulder Mine*** **: The nitrogen load from percolation of 453 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day MPDES permit limit.**

CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 366-486		***Days 366-486:* Second 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. The 453 gpm of excess treated adit waters would be percolated at the East Boulder Mine percolation pond. *(above values used for calculations unless noted here)***		
total inorganic nitrogen concentration **in ground water** resulting from **applied LAD**	0.7 mg/L	**0.6** mg/L	**total inorganic nitrogen concentration in applied LAD** adit water; assume 80% post plant total inorganic nitrogen uptake, C_1	
total inorganic nitrogen concentration in **ground water** resulting from **liner leakage plus applied LAD**	0.7 mg/L	116,324 ft^3/d	**volume of LAD applied**; evaporation factor taken, V_1	
total inorganic nitrogen concentration in **ground water at Mason Ditch** resulting from liner leakage, applied LAD, and Mason Ditch	0.5 mg/L	**2.3** mg/L	**total inorganic nitrogen in** LAD storage **pond liner leakage** discharge, C_2	
CLOSURE total inorganic nitrogen concentration in **ground water downgradient of Mason Ditch,** C_d	**0.5** mg/L	162,847 ft^3/d	ground water discharge volume in cubic feet per day	
CLOSURE East Boulder River total inorganic nitrogen concentration **below Boe Ranch LAD at 5 cfs flow (non-irrigation)**	**0.2** mg/L	1.9 cfs	ground water discharge volume in cubic feet per second	
CLOSURE East Boulder River total inorganic nitrogen concentration below Boe Ranch LAD at **2 cfs flow (irrigation season)**	**0.3** mg/L	projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals		
CLOSURE *Boe Ranch LAD* Total nitrogen load to ground water during closure, Days 1-486	**1,630** lbs/18-mos			

CLOSURE *Boe Ranch LAD* Days 366-486: The nitrogen concentration in ground water from the disposal of 863 gpm (24 hr) treated stored adit water is projected to be less than the DEQ-7 ground water standard of 10 mg/L. The total inorganic nitrogen concentration in surface water downstream of the Boe Ranch LAD from the disposal of 863 gpm (24 hr) treated adit waters in the East Boulder River is projected to be less than 1.0 mg/L.

CLOSURE *East Boulder Mine* nitrogen loading calculations Days 487-548		***Days 487-548:* After the second LAD season, all 737 gpm treated adit water would be routed to the East Boulder Mine percolation pond**	
CLOSURE daily nitrogen load from **percolation Days 487-548**	**20.0** lbs/day	**2.3** mg/L	total inorganic nitrogen concentration of treated adit water
CLOSURE East Boulder Mine Total nitrogen load to ground water Days 1-548	**8,719** lbs/18-mos		

CLOSURE *East Boulder Mine* Days 487-548: The nitrogen load from percolation of 737 gpm treated adit waters at the percolation pond are less than the 30 lbs/day MPDES permit limit.

Agency-Mitigated Alternative 3C CLOSURE Option 1, 150 gpm: SMC would treat 436 gpm (150 gpm adit water and 286 gpm of tailings waters) at closure to reserve hydraulic capacity to empty the East Boulder Mine tailings impoundment in the first 120-day LAD season. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would maximize treated adit and tailings waters disposal (436 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond) at the Boe Ranch LAD area at greater than agronomic rates. After the 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. Up to 150 gpm treated adit water would be disposed at East Boulder Mine days 487 to 548.

CLOSURE *Boe Ranch LAD* Hydraulic Loading		**First LAD Season: Days 1-97, disposal of 436 gpm treated adit and tailings waters with 301 gpm stored treated adit water. Days 98-120, disposal of 150 gpm treated adit water with 310 gpm stored treated adit water. Days 121-365, storage of 150 gpm (24 hr) in the Boe Ranch LAD storage pond until the second LAD season. Days 366-486, and 451 gpm treated adit and stored waters would be land applied. Beginning day 487, all water would be disposed of at the East Boulder Mine.**	
volume in LAD storage pond, assume 8 months stored at 150 gpm	52 MG	**120** days	time to dewater the **LAD storage pond**
Days 1-120 rate to empty **LAD storage pond**	**301** gpm (24 hr)	602 gpm (12 hr)	**LAD storage pond** dewatering rate
Days 1-97 rate to dewater **East Boulder tailings impoundment**	**286** gpm (24 hr)	572 gpm (12 hr)	East Boulder **tailings impoundment** dewatering rate
Days 1-548 adit flow rate at closure	**150** gpm (24 hr)	300 gpm (12 hr)	**adit** flow rate
total pumping rate to dispose of all treated mine waters during 120 day LAD season	737 gpm (24 hr)	**1,474** gpm (12 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season
volume of the East Boulder Tailings impoundment waters needing disposal	40 MG	737 gpm (24 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season

area available for LAD in section 17, all pivots included	166 ac	97 days	number of days to dewater **East Boulder tailings impoundment** at above rate
land application rate that would empty the LAD storage pond in 97 days	9.7 gpm/ac	**1,615** gpm (12 hr)	hydraulic load that can be applied and would empty the LAD storage pond in 97 days
rate that adit water is routed to the **Boe Ranch LAD storage pond** days 1-486	150 gpm (24 hr)	150 gpm (24 hr)	rate of disposal at East Boulder Mine during days 487-548 of closure

Days 1-120: The hydraulic load of 150 gpm (24 hr) treated adit water plus 286 gpm (24 hr) treated tailings waters and 301 gpm (24 hr) Boe Ranch LAD stored waters can be managed at Boe Ranch LAD in one 120 day LAD season without managing any waters at the East Boulder Mine. Days 121-365: The hydraulic load of 150 gpm (24 hr) treated adit water can be stored at the Boe Ranch LAD over the first fall, winter, and spring for disposal during days 366-486. After day 486, the 150 gpm (24 hr) would be percolated at the East Boulder Mine.

CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 1-120		**First LAD Season: Days 1-97, disposal of 436 gpm treated adit and tailings waters with 301 gpm stored treated adit water would occur at the Boe Ranch LAD. Days 98-120, disposal of 150 gpm treated adit water with 310 gpm stored treated adit water would occur at the Boe Ranch LAD.**	
adit flow rate at closure (24 hr rate)	**150** gpm	11.1 mg/L	treated concentration of **adit waters** based on historical maximum nitrogen load
historical maximum post BTS/Anox total inorganic nitrogen load	20 pound/day	**10** mg/L	concentration of treated tailings waters based on 80% total inorganic nitrogen removal by BTS/Anox
Days 1-97 rate to dewater **East Boulder tailings impoundment**	**286** gpm (24 hr)	10.4 mg/L	weighted average of **treated adit plus tailings waters** days 1-97
volume in Boe Ranch LAD storage pond on day 97 if water is applied at greater than agronomic rate listed above	0.04 MG	10.7 mg/L	weighted average concentration of **treated adit, storage pond, and tailings waters** days 1-97
depth of aquifer, **D**	15 ft	11.1 mg/L	weighted average concentration of treated adit water and stored pond water days 98-486
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10 ft		assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone for the LAD storage pond liner leakage, $\mathbf{W_2}$	229 ft		width of source + (tan 5 * length) allowed by statute 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by statute 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_2}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_2}$	3,428 ft^2		D * W, allowed by statute 17.30.517(d)
volume of LAD storage pond **liner leakage**, $\mathbf{V_2}$	27 ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
$\mathbf{Q_2}$=kiA, **ground water** available for mixing below **liner leakage**	97 ft^3/d	3.1 mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in $\mathbf{Q_2}$
concentration of **total inorganic nitrogen in ambient ground water**; median value from RMW-3a, $\mathbf{C_A}$	0.1 mg/L		at closure, this concentration is assumed to be present only in ground water entering the LAD
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_1}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, $\mathbf{W_1}$	3,593 ft^2		allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, $\mathbf{A_1}$	53,901 ft^3/d	**150** gpm (24 hr)	D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, **ground water** available for mixing below **LAD application area**	1,525 ft^3/d	3.1 mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in $\mathbf{Q_1}$
volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	108,818 ft^3/d	565 gpm (24 hr)	evaporation factor applied; hydraulic load to be applied on 166 acres, 9 Section 17 pivots
total inorganic nitrogen concentration in applied LAD adit water; assume 80% post plant total inorganic nitrogen uptake, $\mathbf{C_1}$	**3.1** ft^3/d		concentration of total inorganic nitrogen in Boe Ranch LAD storage pond at beginning of closure

weighted average total inorganic nitrogen in LAD storage **pond liner leakage** discharge days 1-120, C_2	**10.8** mg/L		weighted average concentration of total inorganic nitrogen in Boe Ranch LAD storage pond after mixing with tailings waters for the 120-day season
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, L_3	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft		width of source + (tan 5 * length) allowed by statute 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by statute 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	2.3 mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in Q_3
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **total inorganic nitrogen concentration of Mason Ditch**, C_3	0.1 mg/L		assumed equivalent to the average of EBR-007and EBR-008
total inorganic nitrogen concentration in ground water resulting from **applied LAD**	3.0 mg/L		projected nitrogen concentration using operational ground water values
total inorganic nitrogen concentration in ground water resulting from **liner leakage plus applied LAD**	3.0 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
total inorganic nitrogen concentration in ground water at Mason Ditch resulting from **liner leakage, applied LAD, and Mason Ditch**	2.2 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
CLOSURE total inorganic nitrogen concentration in ground water **downgradient of Mason Ditch,** C_d	**2.2** mg/L		projected cumulative nitrogen ground water concentration using operational ground water values

CLOSURE Days 1-120 ground water at the *Boe Ranch LAD* : The nitrogen concentration in ground water downstream of the Boe Ranch LAD from the disposal of 1,615 gpm (12 hr) treated adit and tailings waters is projected to be less than the DEQ-7 standard of 10 mg/L.

receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow non-irrigation season
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow irrigation season
receiving stream ambient concentration, C_s	0.1 mg/L		KP 2000 Appx K
aquifer discharge volume, Q_d	155,341 ft^3/d	1.8 cfs	ground water discharge in cubic feet per second
aquifer concentration below Mason Ditch, C_d	2.2 mg/L		total inorganic nitrogen concentration in aquifer just prior to discharge to East Boulder River
East Boulder River total inorganic nitrogen concentration non-irrigation season (5.0 cfs)	**0.6** mg/L		projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
East Boulder River total inorganic nitrogen concentration irrigation season (2.0 cfs)	1.1 mg/L		projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals

CLOSURE Days 1-120 surface water at the Boe Ranch LAD: The nitrogen concentration in surface water downstream of the Boe Ranch LAD from the disposal of 1,615 gpm (12 hr) treated adit and tailings waters in the East Boulder River is projected to be less than 1.0 mg/L when East Boulder River flow is greater than 3 cfs. The projected concentration of nitrogen in the East Boulder River would be greater than 1 mg/L total inorganic nitrogen when the East Boulder River flow is 2 cfs.

CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 121-365				**During days 121-365 no disposal of treated adit water would occur; it would be stored at the Boe Ranch LAD storage pond.**
CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 366-486				**During the second LAD season, days 366-486, 150 gpm of treated adit water plus 301 gpm of treated stored water would be disposed at Boe Ranch LAD at greater than agronomic rates. No treated adit water disposal would occur at the East Boulder Mine.**
weighted average total inorganic nitrogen in LAD storage **pond liner leakage** discharge, **C_2**	**11.1** mg/L		**3.2** mg/L	**total inorganic nitrogen concentration in applied LAD** adit water; assume 80% post plant total inorganic nitrogen uptake, **C_1**
CLOSURE total inorganic nitrogen concentration in ground water down-gradient of Mason Ditch, C_d	**2.1** mg/L		86,824 ft^3/d	volume of ground water discharged in cubic feet per day from 451 gpm LAD
East Boulder River below Boe Ranch total inorganic nitrogen concentration 5.0 cfs, non-irrigation season	**0.5** mg/L			projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
East Boulder River below Boe Ranch total inorganic nitrogen concentration 2.0 cfs, irrigation season	**0.8** mg/L			projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals
CLOSURE *Boe Ranch LAD* Total nitrogen load to ground water during closure Days 1-486	**5,092** lbs/18-mos			
CLOSURE *Boe Ranch LAD* nitrogen load Days 487-548				**During days 487 - 548, no water would be disposed at the Boe Ranch LAD.**
CLOSURE *East Boulder Mine* nitrogen load to ground water Days 487-548				**Days 487 - 548: Up to 150 gpm treated adit water would be percolated at the East Boulder Mine.**
CLOSURE Days 487-548 percolation total inorganic nitrogen load at East Boulder Mine	**20.0**	lbs/day	**11.1** mg/L	total inorganic nitrogen concentration of treated adit water
CLOSURE Total total inorganic nitrogen load to ground water disposed at East Boulder Mine during closure days 486-548	**1,240** lbs/18-mos			

CLOSURE Days 487-548 at the *East Boulder Mine*: The nitrogen load from percolation of 150 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day East Bouler Mine MPDES permit limit.

Agency-Mitigated Alternative 3C CLOSURE Option 2, 150 gpm: SMC would treat 436 gpm (150 gpm adit water and 286 gpm of tailings waters) at closure to empty the East Boulder Mine tailings impoundment in 79 days. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. SMC would percolate 200 gpm at the East Boulder Mine to reduce the nitrogen load to the East Boulder River at the Boe Ranch. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would dispose of 236 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond at the Boe Ranch LAD area at greater than agronomic rates. After the first 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. The 150 gpm of treated adit water would be disposed at the East Boulder Mine days 487 to 548 of the 18-month closure period.

CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations			**First LAD Season: Days 1-120, 181 gpm (24 gpm) treated adit and tailings waters with 301 gpm (24 hr) stored treated adit water would be applied at the Boe Ranch LAD. Days 121-365, storage of 150 gpm (24 hr) would occur at the Boe Ranch LAD storage pond until the second LAD season. The second LAD season Days 366-486: 451 gpm treated adit and stored waters would be land applied at Boe Ranch LAD. Days 487-548, no water would be land applied at the Boe Ranch.**
volume in LAD storage pond, assume 8 months stored at 150 gpm	52 MG	**120** days	time to dewater the **LAD storage pond and length of LAD season**
Days 1-120 rate to empty **LAD storage pond**	**301** gpm (24 hr)	602 gpm (12 hr)	**LAD storage pond** dewatering rate
Days 1-120 rate to dewater **East Boulder tailings impoundment**	**231** gpm (24 hr)	463 gpm (12 hr)	East Boulder **tailings impoundment** dewatering rate
Days 1-548 adit flow rate at closure	**150** gpm (24 hr)	300 gpm (12 hr)	**adit** flow rate
Days 1-120 volume of treated water percolated at the East Boulder Mine	**200** gpm (24 hr)	400 gpm (12 hr)	**volume of water percolated** at the East Boulder Mine
total pumping rate to dispose of all treated mine waters during 120 day LAD season	482 gpm (24 hr)	**965** gpm (12 hr)	**total rate** of all treated mine waters needing disposal **at the Boe Ranch LAD**
volume of the East Boulder Tailings impoundment waters needing disposal	40 MG	482 gpm (24 hr)	**total rate** of all treated mine waters needing disposal **at the Boe Ranch LAD**

area available for LAD in section 17, all pivots included	166	ac	120	days	number of days to dewater **East Boulder tailings impoundment** at above rate
land application rate that would empty the LAD storage pond in 120 days	9.7	gpm/ac	**1,615**	gpm (12 hr)	hydraulic load that can be applied **at the Boe Ranch LAD**
rate that adit water is routed to the **Boe Ranch LAD storage pond** days 1-486	150	gpm (24 hr)	150	gpm (24 hr)	rate of disposal at East Boulder Mine during days 487-548 of closure

Days 1-120: The hydraulic load of 181 gpm (24 hr) treated adit plus tailings waters and 301 gpm (24 hr) Boe Ranch LAD stored waters can be managed at Boe Ranch LAD in one 120 day LAD season. Up to 200 gpm (24 hr) treated adit plus tailings waters would be managed at the East Boulder Mine. Days 121-365: The hydraulic load of 150 gpm (24 hr) treated adit water can be stored at the Boe Ranch LAD over the first fall, winter, and spring for disposal during days 366-486. After day 486, the 150 gpm (24 hr) would be percolated at the East Boulder Mine.

CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 1-120			**First LAD Season: Days 1-120, disposal of 181 gpm (24 gpm) treated adit and tailings waters with 301 gpm (24 hr) stored treated adit water would occur at the Boe Ranch LAD and 200 gpm treated adit and tailings waters would be percolated at the East Boulder Mine.**		
adit flow rate at closure (24 hr rate)	**150**	gpm	11.1	mg/L	treated concentration of **adit waters** based on historical maximum nitrogen load
historical maximum post BTS/Anox total inorganic nitrogen load	20	pound/day	**10**	mg/L	concentration of treated tailings waters based on 80% total inorganic nitrogen removal by BTS/Anox
Days 1-120 rate to dewater **East Boulder tailings impoundment**	**231**	gpm (24 hr)	10.4	mg/L	weighted average of **treated adit plus tailings waters** days 1-120
volume in Boe Ranch LAD storage pond on day 120 if water is applied at greater than agronomic rate listed above	0.0	MG	10.7	mg/L	weighted average concentration of **treated adit, storage pond, and tailings waters** days 1-120
depth of aquifer, **D**	15	ft	11.1	mg/L	weighted average concentration of treated adit water and stored pond water days 120-486
hydraulic conductivity, **k**	0.283	ft/d	548	days	**number of days in the 18-month closure period**
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10	ft			assume point leakage from LAD pond exists for foreseeable impact to ground water
width of mixing zone for the LAD storage pond liner leakage, W_2	229	ft			width of source + (tan 5 * length) allowed by statute 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by statute 17.30.517(d)
length of LAD storage pond liner leakage, L_2	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_2	3,428	ft^2			D * W, allowed by statute 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27	ft^3/d	0.14	gpm (24 hr)	KP 2000c Apdx K, Tables
Q_2=kiA, **ground water** available for mixing below **liner leakage**	97	ft^3/d	1.2	mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in Q_2
concentration of **total inorganic nitrogen in ambient ground water**; median value from RMW-3a, C_A	0.1	mg/L			at closure, this concentration is assumed to be present only in ground water entering the LAD
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, L_1	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, W_1	3,593	ft^2			allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, A_1	53,901	ft^3/d	**150**	gpm (24 hr)	D * W, allowed by 17.30.517(d)
Q_1=kiA, **ground water** available for mixing below **LAD application area**	1,525	ft^3/d	0.1	mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in Q_1
volume of LAD applied; evaporation factor taken, V_1	65,019	ft^3/d	338	gpm (24 hr)	evaporation factor applied; hydraulic load to be applied on 166 acres, 9 Section 17 pivots

total inorganic nitrogen concentration in applied LAD adit water; assume 80% post plant total inorganic nitrogen uptake, $\mathbf{C_1}$	**3.1** ft^3/d		concentration of total inorganic nitrogen in Boe Ranch LAD storage pond at beginning of closure
weighted average total inorganic nitrogen in LAD storage **pond liner leakage** discharge days 1-120, $\mathbf{C_2}$	**10.7** mg/L		weighted average concentration of total inorganic nitrogen in Boe Ranch LAD storage pond after mixing with tailings waters for the 120-day season
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by statute 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		D * W, allowed by statute 17.30.517(d)
$\mathbf{Q_3}$=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	1.2 mg/L	**assumed operational total inorganic nitrogen concentration** for ground water in Q_3
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), $\mathbf{V_3}$	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **total inorganic nitrogen concentration of Mason Ditch**, $\mathbf{C_3}$	0.1 mg/L		assumed equivalent to the average of EBR-007and EBR-008
total inorganic nitrogen concentration in ground water resulting from **applied LAD**	3.0 mg/L		projected nitrogen concentration using operational ground water values
total inorganic nitrogen concentration in ground water resulting from **liner leakage plus applied LAD**	3.0 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
total inorganic nitrogen concentration in ground water at Mason Ditch resulting from **liner leakage, applied LAD, and Mason Ditch**	1.8 mg/L		projected cumulative nitrogen ground water concentration using operational ground water values
CLOSURE total inorganic nitrogen concentration in ground water **downgradient of Mason Ditch,** $\mathbf{C_d}$	**1.8** mg/L		projected cumulative nitrogen ground water concentration using operational ground water values

CLOSURE Days 1-120 ground water at the *Boe Ranch LAD*: The nitrogen concentration in ground water downstream of the Boe Ranch LAD from the disposal of 1,615 gpm (12 hr) treated adit and tailings waters is projected to be less than the DEQ-7 standard of 10 mg/L.

receiving streamflow non-irrigation season, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow non-irrigation season
receiving streamflow irrigation season, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow irrigation season
receiving stream ambient concentration, $\mathbf{C_s}$	0.1 mg/L		KP 2000 Appx K
aquifer discharge volume, $\mathbf{Q_d}$	111,542 ft^3/d	1.3 cfs	ground water discharge in cubic feet per second
aquifer concentration below Mason Ditch, $\mathbf{C_d}$	1.8 mg/L		total inorganic nitrogen concentration in aquifer just prior to discharge to East Boulder River
East Boulder River total inorganic nitrogen concentration non-irrigation season (5.0 cfs)	**0.4** mg/L		projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
East Boulder River total inorganic nitrogen concentration irrigation season (2.0 cfs)	**0.8** mg/L		projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals

CLOSURE Days 1-120 surface water at the Boe Ranch LAD: The nitrogen concentration in surface water downstream of the Boe Ranch LAD from the disposal of 1,615 gpm (12 hr) treated adit and tailings waters in the East Boulder River is projected to be less than 1.0 mg/L when East Boulder River flow is greater than 3 cfs. The projected concentration of nitrogen in the East Boulder River would be greater than 1 mg/L total inorganic nitrogen when the East Boulder River flow is less than 2 cfs.

CLOSURE *East Boulder Mine* nitrogen loading calculations Days 1-120

CLOSURE Days 1-120 rate of water percolated at East Boulder Mine	**200** gpm (24 hr)	**10.4** mg/L	total inorganic nitrogen concentration of treated adit plus tailings water
CLOSURE Days 1-120 percolation total inorganic nitrogen load at East Boulder Mine	**25.0** lbs/day		

CLOSURE total inorganic nitrogen load to ground water disposed at the East Boulder Mine days 1-120	**3,005 lbs/120 days**

CLOSURE Days 1-120 at the *East Boulder Mine* : The nitrogen load from percolation of 150 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day East Bouler Mine MPDES permit limit.

CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 121-365						**During days 121-365 no disposal of treated adit water would occur; treated adit would be stored at the Boe Ranch LAD storage pond.**
CLOSURE *Boe Ranch LAD* nitrogen loading calculations Days 366-486						**During the second LAD season, days 366-486, 150 gpm of treated adit water plus 301 gpm of treated stored water would be disposed at Boe Ranch LAD at greater than agronomic rates. No treated adit water disposal would occur at the East Boulder Mine.**
volume of water in Boe Ranch LAD storage pond on day 366, assume 8 months stored volume at 150 gpm	**52**	**MG**				
weighted average total inorganic nitrogen in LAD storage **pond liner leakage** discharge, **C_2**	**11.1**	mg/L		**3.2**	mg/L	**total inorganic nitrogen concentration in applied LAD** adit water; assume 80% post plant total inorganic nitrogen uptake, **C_1**
CLOSURE total inorganic nitrogen concentration in ground water down-gradient of Mason Ditch, C_d	**2.1**	mg/L		86,824	ft^3/d	volume of ground water discharged in cubic feet per day from 451 gpm LAD
East Boulder River below Boe Ranch total inorganic nitrogen concentration 5.0 cfs, non-irrigation season	**0.4**	mg/L				projected total inorganic nitrogen concentration in East Boulder River at non-irrigation flow
East Boulder River below Boe Ranch total inorganic nitrogen concentration 2.0 cfs, irrigation season	**0.7**	mg/L				projected total inorganic nitrogen concentration in East Boulder River during irrigation withdrawals
CLOSURE *Boe Ranch LAD* Total nitrogen load to ground water during closure days 1-486	**3,035**	lbs				
CLOSURE total inorganic nitrogen Calculations for Boe Ranch LAD Days 487-548	**0**	lbs/day				**During days 487 - 548, no water would be disposed at the Boe Ranch LAD.**
CLOSURE *Boe Ranch LAD* Total nitrogen load to ground water during closure davs 1 - 548	**3,035**	lbs/18-mos				**Up to 150 gpm treated adit water would be percolated at the East Boulder Mine.**
CLOSURE *East Boulder Mine* nitrogen load Days 487-548	**20.0**		lbs/day	**11.1**	mg/L	total inorganic nitrogen concentration of treated adit water
CLOSURE *East Boulder Mine* nitrogen load to ground water during closure days 486-548	**1,240**	lbs/62 days		**4,245**	lbs/18-mos	**CLOSURE Total total inorganic nitrogen load to ground water disposed at the East Boulder Mine during 18-month closure days 1-548**

CLOSURE Days 487-548 at the *East Boulder Mine* : The nitrogen load from percolation of 150 gpm treated adit and tailings waters at the percolation pond are less than the 30 lbs/day East Boulder Mine MPDES permit limit.

Spreadsheet 3C Salts: Agency-Mitigated Alternative 3C Boe Ranch LAD System Operations and Closure Salinity Analyses

Per KP 2000c, if the Boe Ranch LAD were constructed it would be the agencies' preferred disposal option for treated adit water during operations and for treated adit plus tailings waters during the first eighteen months of closure. The East Boulder Mine percolation pond would be used for contingency disposal of treated adit water during operations. Monitoring well RMW-3A is located at the Boe Ranch downgradient of the proposed LAD and is considered to represent ambient electrical conductivity (EC) values. Based on EC measurements at RMW-3A, the average EC of ground water at Boe Ranch is 1,025 µmhos/cm having a Class II Beneficial Use with an electrical conductivity criteria between 1,000 to 2,500 µSiemens/cm (equivalent to µmhos/cm). The measured median total dissolved salts (TDS) concentration of the ground water is 721 mg/L. For this analysis, the agencies calculated the TDS concentration from the EC of ground water. Ambient median salts concentrations in the East Boulder River up- and downstream of the Boe Ranch are 270 mg/L TDS at EBR-007 and 340 mg/L at EBR-008, respectively. At closure, adit and East Boulder tailings waters would be treated for nitrogen through the BTS/Anox system then preferentially routed to Boe Ranch LAD storage pond and disposed of through LAD pivots during the summer LAD season. For the Boe Ranch LAD calculations have been made according to the regulatory requirements of the Montana Water Quality Act and Rules and Federal Clean Water Act regarding surface and ground water mixing zones. No dilution from precipitation (recharge) was assumed. For the Boe Ranch LAD any water that percolates below the root zone is assumed to immediately enter the aquifer. The Boe Ranch LAD area would not have an MPDES permit. Salts are not treated in the BTS/Anox system or during LAD, so all concentrations of salt are expected to flush through the soil column/unsaturated zone to ground water. Ground water flows beneath the LAD area and LAD storage pond, flows downgradient where it is recharged by the Mason Ditch, then discharges to the East Boulder River. These calculations assume that during operations, treated adit waters are routed to the Boe Ranch LAD storage pond. PoleCat evaporators accomplish summer 30% evaporation, center pivots 30%; PoleCat winter snowmaking 30% evaporation up slope of the lined LAD storage pond. At closure, treated adit and tailings waters would be routed to the Boe Ranch LAD storage pond which would hold up to 100 MG of adit waters, and mixing of these waters occurs prior to disposal at the LAD pivots. A weighted average was used to determine the concentration of salts in the mixed LAD storage pond water. The East Boulder Mine MPDES permit sets no total dissolved solids (TDS) or electrical conductivity (EC) limits. Median adit and tailings TDS concentrations were used in these calculations. Salts loading is calculated using TDS concentrations. These calculations assume that there will be a leak in the Boe Ranch LAD storage pond, and the liner leakage, applied LAD, and Mason Ditch waters contribute to ground water quality prior to discharge into the East Boulder River. It is assumed that 9 of the 10 proposed Boe Ranch LAD center pivots on 166 acres will be developed for use during operations and closure. Only 50 percent of pivots 4 and 9 were used to address concerns regarding mass wasting.

OPERATIONS CALCULATIONS

Alternative 3C Operations Option 1, 737 gpm: SMC would route 284 gpm treated adit water to the Boe Ranch LAD storage pond during the entire year. Treated adit water stored in the Boe Ranch LAD storage pond over fall, winter, and early spring, would be disposed during the Boe Ranch LAD season. During the 120-day LAD season the 284 gpm treated adit water would be disposed with up to 579 gpm stored treated adit water on the 166-acre Boe Ranch LAD area at greater than agronomic rates (10.4 gpm/acre) to prevent salts build-up in the soil. The excess 453 gpm of treated adit water would be disposed at the East Boulder Mine during the entire year. During the LAD season at the mine, 293 gpm would be disposed at the East Boulder Mine LAD Area 6 and 160 gpm at the East Boulder Mine percolation pond. During snowmaking season, 205 gpm could be disposed at the East Boulder Mine LAD Area 6 and 248 gpm at the percolation pond. The rest of the year, 453 gpm treated adit water would be disposed at the East Boulder Mine percolation pond.

1 ppm TDS = 1.56 µmhos/cm		120 days	length of LAD season
OPERATIONS *Boe Ranch LAD* Hydraulic Loading Calculations		***OPERATIONS:*** **assume Boe Ranch LAD storage pond is full on the first day of the LAD season**	
area available for LAD in section 17, **not all pivots** included (prevent mass wasting issues)	166 ac	**1,726** gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4 gpm/ac	569 gpm (12 hr)	**LAD capacity available** at Boe Ranch LAD **for adit water** after dewatering Boe Ranch LAD storage pond
assumed volume in Boe Ranch LAD storage pond	100 MG	**1,157** gpm (12 hr)	rate to dewater Boe Ranch LAD storage pond in one season
adit flow rate during operations	**737** gpm (24 hr)	1,474 gpm (12 hr)	adit flow rate during operations
adit flow rate that must be managed at **East Boulder Mine**	**453** gpm (24 hr)	905 gpm (12 hr)	**adit** flow rate that must be **managed at East Boulder Mine**
summer hydraulic capacity available at East Boulder Mine at **LAD Area 6**	293 gpm (24 hr)	115 days	time to fill Boe Ranch LAD storage pond with adit water after 120 day LAD season
winter hydraulic capacity available at East Boulder Mine at **LAD Area 6**	205 gpm (24 hr)	1,105 gpm (24 hr)	capacity of East Boulder Mine percolation pond (MPDES permit Statement of Basis)
summer excess adit flow rate that must be **percolated** at East Boulder Mine	**160** gpm (24 hr)	248 gpm (24 hr)	**winter** excess adit flow rate that must be **percolated** at East Boulder Mine
volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	569 gpm (12 hr)	volume of water routed to **Boe Ranch LAD year round**

OPERATIONS During the 120 day LAD season, the hydraulic load of 284 gpm treated adit water plus 579 gpm treated stored water can be managed at Boe Ranch LAD area if seven pivots are operating at greater than agronomic rates as is done at the Hertzler Ranch LAD area. The excess water 453 gpm would be disposed at the East Boulder Mine LAD Area 6 and percolation pond.

OPERATIONS *East Boulder Mine* Mixing Zone Salinity Calculations		**The aquifer at the East Boulder Mine has a Class I Beneficial Use.**	
East Boulder Source-Specific percolation pond mixing zone imputs		**160** gpm (24 hr)	adit water percolated at East Boulder Mine percolation pond in **summer**
		248 gpm (24 hr)	adit water percolated at East Boulder Mine percolation pond in **winter**
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, L_1	3600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	77,005 ft^3/d	400 gpm	MPDES Statement of Basis, p. 25-26
ambient concentration of TDS in ground water (median at WW-1), C_A	**106** mg/L	165 μmhos/cm	CES 2008 Apdx D, EBoulder Mine TDS Table p 2, central value
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, W_1	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_1	55,977 ft^2		D * W, allowed by 17.30.517(d)
70% volume of ground water available for mixing Q_1=kiA_1	76,409 ft^3/d		MPDES Statement of Basis, p.25-26
Volume of adit water percolated in summer, V_p	30,707 ft^3/d	**160** gpm (24 hr)	adit water percolated at East Boulder Mine in **summer;** no evaporation
Volume of adit water percolated in winter, V_p	47,648 ft^3/d	**248** gpm (24 hr)	adit water percolated at East Boulder Mine in **winter;** no evaporation
depth of aquifer, D_2	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, L_2	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, W_2	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_2	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of ground water available for mixing Q_2=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
volume of adit water land applied in summer, V_2	39,484 ft^3/d	205 gpm (12 hr)	capacity of East Boulder LAD Area 6 in summer, evaporation credit taken
volume of adit water land applied in winter, V_2	27,626 ft^3/d	144 gpm (12 hr)	capacity of East Boulder LAD Area 6 in winter, evaporation credit taken
2000-2008 median concentration of salt in adit water (CES 2008), C_1	**550** mg/L	**786** mg/L	effective concentration of salt in land applied waters
receiving stream ambient concentration at EBR-001, Q_c	**49** mg/L	76 μmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
receiving streamflow, Q_s	423,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4

OPERATIONS *East Boulder Mine* Summer Salinity Calculations			***Summer:*** **Percolation of 160 gpm (24 hr) at East Boulder Mine and 293 gpm (24 hr) at LAD at Area 6**	
salts concentration in ground water *East Boulder Mine*	338 mg/L		**527** µmhos/cm	projected summer salts concentration in ground water near SP-11
salts concentration in East Boulder River *below East Boulder Mine*	**129** mg/L		201 µmhos/cm	projected summer salts concentration in surface water near EBR-004/EBR-004A

OPERATIONS: Summer disposal of 293 gpm (24 hr) treated adit water at LAD Area 6 and 160 gpm (24 hr) at the percolation pond would not exceed the Class I beneficial use criterion or the 250 mg/L TDS recommendation protective of trout eggs in the East Boulder River at the East Boulder Mine.

OPERATIONS *East Boulder Mine* Winter Salinity Calculations			***Winter:*** **Percolation of 248 gpm (24 hr) at East Boulder Mine and 205 gpm (24 hr) at LAD at Area 6**	
salts concentration in ground water *East Boulder Mine*	306 mg/L		**478** µmhos/cm	projected winter salts concentration in ground water near SP-11
salts concentration in East Boulder River below *East Boulder Mine*	**132** mg/L		206 µmhos/cm	projected winter salts concentration in surface water near EBR-004/EBR-004A

OPERATIONS: Winter disposal of 205 gpm (24 hr) treated adit water at LAD Area 6 and 248 gpm (24 hr) at the percolation pond would not exceed the Class I beneficial use criterion or the 250 mg/L TDS recommendation protective of trout eggs in the East Boulder River at the East Boulder Mine.

OPERATIONS: *East Boulder Mine* Percolation Salinity Calculations			***OPERATIONS:*** **Percolation of up to 453 gpm (24 hr) at the East Boulder Mine when LAD cannot occur**	
salts concentration in ground water *East Boulder Mine*	308 mg/L		**508** µmhos/cm	projected salts concentration in ground water near EBMW-006 or EBMW-007
salts concentration in East Boulder River *below East Boulder Mine*	**100** mg/L		156 µmhos/cm	projected salts concentration in surface water near EBR-004/EBR-004A

OPERATIONS: Percolation of 453 gpm (24 hr) at the East Boulder Mine percolation pond would not exceed the Class I beneficial use criterion or the 250 mg/L TDS recommendation protective of trout eggs in the East Boulder River at the East Boulder Mine.

OPERATIONS *Boe Ranch LAD* Mixing Zone Salinity Calculation Input Values		***OPERATIONS:*** **LAD of 284 gpm treated adit water plus up to 579 gpm (24 hr) stored treated adit water at greater than agronomic rates on 166 acres; the aquifer at the Boe Ranch has a Class II Beneficial Use.**	
2000-2008 median East Boulder adit EC concentration, calculated from TDS	**858** µmhos/cm	**550** mg/L	2000-2008 median East Boulder adit TDS concentration; CES 2008 page 13
depth of aquifer, **D**	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283 ft/d		mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1		estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10 ft		assume point leakage from LAD pond exists for foreseeable impact to aquifer
width of mixing zone for the LAD storage pond liner leakage, $\mathbf{W_2}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_2}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_2}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27 ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
$\mathbf{Q_2}$=kiA, **ground water** available for mixing below **liner leakage**	97 ft^3/d		KP 2000c Apdx K, Tables
concentration of **salts in ambient ground water**; median value from RMW-3a, $\mathbf{C_A}$	**1,025** µmhos/cm	**657** mg/L	median ambient TDS concentration derived from SMC monitoring data
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_1}$	4,500 ft		KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, $\mathbf{W_1}$	3,593 ft		allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, $\mathbf{A_1}$	53,901 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, **ground water** available for mixing below **LAD application area**	1,525 ft^3/d		allowed by 17.30.517(d)

volume of LAD applied; evaporation factor taken, V_1	116,324 ft^3/d	**1,208** gpm (12 hr)	treated adit water stored in Boe Ranch LAD storage pond; evaporation credit taken
salts concentration in applied LAD adit water; assume pivots 30% evaporation, no post plant salt uptake credit, C_1	**1,226** µmhos/cm	**786** mg/L	effective applied LAD TDS concentration
salts in LAD storage **pond liner leakage** discharge, C_2	**858** µmhos/cm	**550** mg/L	median adit TDS concentration derived from SMC monitoring data
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, L_3	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d		allowed by 17.30.517(d)
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,123 ft^3/d	224 gpm	KP 2000c Apdx K, Tables
assumed **salts concentration of Mason Ditch** , C_3	**476** µmhos/cm	**305** mg/L	SMC Monitoring Data, assumed equal to average of EBR-007 and EBR-008
OPERATIONS Ground water calculations down-gradient of Boe Ranch LAD			***OPERATIONS:*** **LAD of 284 gpm treated adit water plus up to 579 gpm (24 hr) stored treated adit water at greater than agronomic rates on 166 acres; the aquifer at the Boe Ranch has a Class II beneficial use.**
salts concentration in ground water resulting **from applied LAD**	**1,223** µmhos/cm	784 mg/L	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_1
salts concentration in ground water resulting **from liner leakage plus applied LAD**	**1,223** µmhos/cm	784 mg/L	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration** in ground water for Q_2
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	**1,023** µmhos/cm	656 mg/L	projected cumulative salts concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration of salts** in ground water below the Mason Ditch to the East Boulder River, Q_3
OPERATIONS salts concentration in ground water below Mason Ditch, C_d	**1,023** µmhos/cm	656 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
OPERATIONS: Summer disposal of 863 gpm (24 hr) treated adit water at the Boe Ranch LAD would result in a ground water concentration less than the Class II beneficial use criterion of 2,500 µmhos/cm.			
OPERATIONS East Boulder River calculations down-gradient of Boe Ranch LAD			***OPERATIONS*** **: LAD of 284 gpm treated adit water plus up to 579 gpm (24 hr) stored treated adit water at greater than agronomic rates on 166 acres; the aquifer at the Boe Ranch has a Class II beneficial use.**
receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow non-irrigation season
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow irrigation season
receiving stream ambient concentration, C_s	530 µmhos/cm	**340** mg/L	2000-2005 median value for EBR-008 SMC Monitoring data
ground water discharge volume, Q_d	162,771 ft^3/d	1.9 cfs	ground water discharge volume in cubic feet per second
aquifer concentration below Mason Ditch, C_d	1,023 µmhos/cm	656 mg/L	salt concentration in aquifer just prior to discharge to East Boulder River
East Boulder River salt concentration down-gradient of LAD at **5.0 cfs**	665 µmhos/cm	**426 mg/L**	TDS value calculated from EC at 5 cfs; this value is a 25% increase in salts concentration from ambient TDS concentrations at EBR-008
East Boulder River salt concentration down-gradient of LAD at **2.0 cfs**	769 µmhos/cm	**493 mg/L**	TDS value calculated from EC at 2 cfs; this value is a 45% increase in salts concentration from ambient TDS concentrations at EBR-008

OPERATIONS: Disposal of 1,726 gpm (12 hr) treated adit and Boe Ranch LAD storage pond waters produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient 340 mg/L TDS concentration in the East Boulder River at EBR-008 and the median TDS concentration of treated adit water, there is no volume of adit water that could be land applied at a rate that would reduce the TDS concentration at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.

Alternative 3C TIN OPERATIONS Option 1, 150 gpm: SMC would route 150 gpm (24 hr) treated adit water to the Boe Ranch LAD storage pond all year. The 150 gpm (24 hr) of treated adit water and 301 gpm (24 hr) of stored treated adit water would be disposed at Boe Ranch LAD at greater than agronomic rates during the 120-day LAD season. No treated adit water disposal would occur at the East Boulder Mine.

OPERATIONS Hydraulic Loading Calculations for Boe Ranch LAD					***OPERATIONS*** **assume 120 day LAD season and that Boe Ranch LAD storage pond contains 52 MG from previous winter; LAD of 150 gpm treated adit water and 301 gpm stored water; the aquifer at the Boe Ranch has a Class II beneficial use**
capacity of LAD Storage Pond	100	MG	120	days	time to dewater the LAD storage pond
assumed volume in LAD storage pond	52	MG	301	gpm (24 hr)	pumping rate to empty **Boe Ranch LAD storage pond**
area available for LAD in section 17,not all pivots included	166	ac	602	gpm (12 hr)	Boe Ranch LAD storage pond dewatering rate
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4	gpm/ac	**1,726**	gpm (12 hr)	**hydraulic load** that can be applied on 166 acres, in Section 17
adit flow rate	**150**	gpm (24 hr)	**902**	gpm (12 hr)	rate of LAD to dispose of adit plus stored water

OPERATIONS During the 120 day LAD season, the (24 hr) hydraulic load of 150 gpm adit water plus 602 gpm (12 hr) rate to dewater stored water in the Boe Ranch LAD storage pond (52 MG) can be managed at Boe Ranch LAD area if not all pivots are operating on 166 acres at greater than agronomic rates, as is done at Hertzler Ranch LAD.

OPERATIONS *Boe Ranch LAD* Salinity Calculations	858	μmhos/cm	**550**	mg/L	2000-2008 median adit TDS concentration; CES 2008 page 13
depth of aquifer, **D**	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	0.283	ft/d			mid-range estimate, used by Hydrometrics (KP 2000c)
gradient, **i**	0.1				estimate, used by Hydrometrics (KP 2000c)
width of LAD storage pond liner leakage source	10	ft			assume point leakage from LAD pond exists for foreseeable impact to aquifer
width of mixing zone for the LAD storage pond liner leakage, W_2	229	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_2	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_2	3,428	ft^2			D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27	ft^3/d	0.14	gpm (24 hr)	KP 2000c Apdx K, Tables
Q_2=kiA, **ground water** available for mixing below **liner leakage**	97	ft^3/d			KP 2000c Apdx K, Tables
concentration of **salts in ambient ground water**; median value from RMW-3a, C_A	**1,025**	μmhos/cm	**657**	mg/L	median ambient TDS concentration derived from SMC monitoring data
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables
length of LAD application, L_1	4,500	ft			KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, W_1	3,593	ft			allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, A_1	53,901	ft^2			D * W, allowed by 17.30.517(d)
Q_1=kiA, **ground water** available for mixing below **LAD application area**	1,525	ft^3/d			allowed by 17.30.517(d)
volume of LAD applied; evaporation factor taken, V_1	121,533	ft^3/d	**631**	gpm (12 hr)	treated adit water stored in Boe Ranch LAD storage pond; evaporation credit taken
salts concentration in applied LAD adit water; assume pivots 30% evaporation, no post plant salt uptake credit, C_1	**1,226**	μmhos/cm	**786**	mg/L	effective applied LAD TDS concentration
salts in LAD storage **pond liner leakage** discharge, C_2	**858**	μmhos/cm	**550**	mg/L	median adit TDS concentration derived from SMC monitoring data
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593	ft			KP 2000c Apdx K, Tables

length between end of pivots to East Boulder River, L_3	4,000 ft			KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943 ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2			D * W, allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	**150** gpm (24 hr)		adit flow rate
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,200 ft^3/d	224 gpm		KP 2000c Apdx K, Tables
assumed **salts concentration of Mason Ditch** , C_3	320 μmhos/cm	**305** mg/L		SMC Monitoring Data, assumed equal to average of EBR-007 and EBR-008
salts concentration in ground water resulting **from applied LAD**	**1,223** μmhos/cm	784 mg/L		projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_1
salts concentration in ground water resulting **from liner leakage plus applied LAD**	**1,223** μmhos/cm	784 mg/L		projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration** in ground water for Q_2
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	**989** μmhos/cm	634 mg/L		projected cumulative salts concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration of salts** in ground water below the Mason Ditch to the East Boulder River, Q_3
OPERATIONS salts concentration in ground water below Mason Ditch, C_d	**989** μmhos/cm	634 mg/L		compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River

OPERATIONS: Summer disposal of 902 gpm (24 hr) treated adit water at the Boe Ranch LAD would result in a salts concentration in ground water less than the Class II beneficial use criterion of 2,500 μmhos/cm.

OPERATIONS East Boulder River calculations down-gradient of Boe Ranch LAD			***OPERATIONS*** **assume 120 day LAD season and that Boe Ranch LAD storage pond contains 52 MG from previous winter; LAD of 150 gpm treated adit water and 301 gpm stored water; the aquifer at the Boe Ranch has a Class II beneficial use**
receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow non-irrigation season
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow irrigation season
receiving stream ambient concentration, C_s	530 μmhos/cm	**340** mg/L	2000-2005 median value for EBR-008 SMC Monitoring data
ground water discharge volume, Q_d	168,056 ft^3/d	2.0 cfs	ground water discharge volume in cubic feet per second
aquifer concentration below Mason Ditch, C_d	989 μmhos/cm	634 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
OPERATIONS East Boulder River salt concentration below Boe Ranch LAD area 5.0 cfs	659 μmhos/cm	**422 mg/L**	TDS value calculated from EC at 5 cfs; this value is a **24% increase in salts concentration from ambient TDS** concentrations at EBR-008
OPERATIONS East Boulder River salt concentration below Boe Ranch LAD area 2.0 cfs	756 μmhos/cm	**485 mg/L**	TDS value calculated from EC at 2 cfs; this value is a **43% increase in salts concentration from ambient TDS** concentrations at EBR-008

OPERATIONS: Disposal of 902 gpm (12 hr) treated adit and Boe Ranch LAD storage pond waters produces a TDS concentration in the East Boulder River greater than 250 mg/L.Given the ambient 340 mg/L TDS concentration in the East Boulder River at EBR-008 and the median TDS concentration of treated adit water, there is no volume of adit water that could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.

CLOSURE CALCULATIONS

Agency-Mitigated Alternative 3C CLOSURE Option 1, 737 gpm: At closure, SMC would treat 737 gpm adit water and 263 gpm tailings waters in the BTS. The closure time frame would be 18 months. *Days 1-120:* SMC would maximize disposal of 284 gpm treated adit and tailings waters at the Boe Ranch LAD area at greater than agronomic rates. SMC would dispose of the remaining 716 gpm at the East Boulder Mine. LAD Area 6 would receive 293 gpm and the excess 423 gpm would be routed to the East Boulder Mine percolation pond during the first 120-day summer LAD season in the 18 month closure period.

Days 121-365: **After day 120, the tailings impoundment would be closed and only 737 gpm of treated adit water would need disposal during the rest of the 18-month closure period. From days 121-365, up to 284 gpm would be routed to the Boe Ranch LAD storage pond, and 453 gpm would be disposed at the East Boulder MIne percolation pond.**

Days 366-548: **During the second year 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters in the Boe Ranch LAD storage pond. After the second year LAD season, all 737 gpm of treated adit water would be disposed at the East Boulder Mine percolation pond.**

2000-2005 average field and laboratory EC at RMW-3A, SMC Monitoring Data	**1,025** μmhos/cm	**657** mg/L	calculated TDS concentration at RMW-3A, based on SMC Monitoring Data
	858 μmhos/cm	**550** mg/L	2000-2008 median adit TDS concentration; CES 2008 page 13
	1,399 μmhos/cm	**897** mg/L	2002-2006 median tailings waters TDS concentration (CES 2008 p 13)
	1,000 μmhos/cm	**641** mg/L	weighted average TDS concentration of treated adit plus tailings waters

CLOSURE Hydraulic Loading Calculations 737 gpm adit water *Days 1-120*			***CLOSURE: Days 1-120:*** **Disposal of 284 gpm treated adit and tailings waters with 579 gpm stored treated adit water at the Boe Ranch LAD; disposal of 293 at the East Boulder Mine LAD Area 6, and 423 gpm at the percolation pond; no winter LAD disposal would occur at East Boulder Mine**
area available for LAD in section 17, to prevent mass wasting/stability issues	166 ac	**1,726** gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, in Section 17
assumed Boe Ranch **LAD storage pond volume**	100 MG	10.4 gpm/ac	**greater than agronomic land application rate** used at Hertzler Ranch LAD area (SMC Monitoring data)
adit flow rate at closure	**737** gpm (24 hr)	**284** gpm (24 hr)	volume of water sent to **Boe Ranch LAD storage pond** year round
rate to dewater **East Boulder tailings impoundment**	**263** gpm (24 hr)	40 MG	volume of the **East Boulder Tailings impoundment waters** needing disposal
time to dewater the East Boulder tailings impoundment	106 days	569 gpm (12 hr)	**LAD capacity available** at Boe Ranch LAD **for adit water** after dewatering Boe Ranch LAD storage pond
hydraulic capacity available at East Boulder Mine at **LAD Area 6**	**293** gpm (24 hr)	**716** gpm (24 hr)	**excess** water that must be **managed at East Boulder Mine**
excess adit and tailings waters that must be **percolated** at East Boulder Mine	**423** gpm (24 hr)	579 gpm (24 hr)	rate to **dewater Boe Ranch LAD storage pond** in one season
rate to **dewater Boe Ranch LAD storage pond** in one season	**1,157** gpm (12 hr)	1,105 gpm (24 hr)	capacity of East Boulder Mine percolation pond (MPDES permit Statement of Basis)
CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations *Days 121-365*			***CLOSURE: Days 121-365:*** **Of the 737 gpm treated adit water, 284 gpm would be routed to the Boe Ranch LAD storage pond and 453 gpm would be routed to the East Boulder Mine percolation pond**
volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	**453** gpm (24 hr)	excess adit waters that must be **percolated** at East Boulder Mine
CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations *Days 366-486*			***CLOSURE: Days 366-486:*** **Second 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. Excess waters would be percolated at the East Boulder Mine percolation pond.**
greater than agronomic land application rate used at Hertzler Ranch LAD area (SMC Monitoring data)	10.4 gpm/ac	**1,726** gpm (12 hr)	**hydraulic load** that can be land applied at greater than agronomic rates for 120 days on 166 acres, in Section 17
assumed Boe Ranch **LAD storage pond volume**	100 MG	0 MG	East Boulder **tailings waters volume**
rate to dewater Boe Ranch LAD storage pond in one season	579 gpm (24 hr)	1,157 gpm (12 hr)	rate to **dewater Boe Ranch LAD storage pond** in one season
volume of water routed to **Boe Ranch LAD year round**	**284** gpm (24 hr)	**453** gpm (24 hr)	excess treated adit water that must be **percolated** at East Boulder Mine
CLOSURE *East Boulder Mine* Hydraulic Loading Calculations *Days 487-548*			***CLOSURE: Days 487-548:*** **After the second LAD season, all 737 gpm treated adit water would be routed to the East Boulder Mine percolation pond**
treated adit water that must be **percolated** at East Boulder Mine	**737** gpm (24 hr)	0 MG	East Boulder **tailings waters volume**

The hydraulic load of 737 gpm plus 263 gpm tailings waters can be managed at the East Boulder Mine and the Boe Ranch LAD area under Option 1, 737 gpm.

CLOSURE *East Boulder Mine* salinity calculations *Days 1-120*			CLOSURE: *Days 1-120:* Disposal of 293 gpm treated adit and tailings waters at the East Boulder Mine LAD Area 6, and 423 gpm treated adit and tailings waters at the percolation pond; no winter LAD disposal would occur at East Boulder Mine; the aquifer at the East Boulder Mine has a Class I beneficial use
depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to wells, L_1	3,600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	77,005 ft^3/d	400 gpm	MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in aquifer (median at WW-1), C_A	106 mg/L	165 µmhos/cm	SMC Monitoring Data
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, W_1	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_1	55,977 ft^2		D * W, allowed by 17.30.517(d)
70% Volume of aquifer available for mixing Q_1=kiA_1	76,409 ft^3/d		MPDES Statement of Basis, p.25-26
Volume of adit water percolated at East Boulder Mine, V_p	81,338 ft^3/d	**423** gpm (24 hr)	volume of treated adit and tailings waters percolated at East Boulder Mine
depth of aquifer, D_2	15 ft		allowed by 17.30.517(d)
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from percolation pond to river, L_2	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, W_2	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, A_2	14,303 ft^2		D * W, allowed by 17.30.517(d)
Volume of aquifer available for mixing Q_2=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
weighted average TDS concentration in mixed percolated waters, C_P	**641** mg/L	**1,000** µmhos/cm	
effective weighted average TDS concentration in mixed land applied waters, C_{LAD}	**916** mg/L	**1,429** µmhos/cm	
volume of land applied treated adit plus tailings waters (evaporation credit taken), V_{2LAD}	39,484 ft^3/d	**205** gpm (24 hr)	Days 1-120 rate land application at East Boulder Mine LAD Area 6 (evaporation applied)
receiving stream baseline ambient concentration at EBR-001, Q_c	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
receiving streamflow, Q_s	423,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4
CLOSURE *East Boulder Mine* Days 1-120: Salts concentration in ground water	511 mg/L	**798** µmhos/cm	projected salts concentration near SP-11 from percolation and disposal at LAD Area 6
CLOSURE *East Boulder Mine* Days 1-120 Salts concentration in East Boulder River	**210** mg/L	327 µmhos/cm	projected salts concentration at EBR-004/004A from percolation and disposal at LAD Area 6

CLOSURE *East Boulder Mine* Days 1-120: Percolation of 423 gpm (24 hr) treated adit and tailings waters and land application of 293 gpm (24 hr) at LAD Area 6 at the East Boulder Mine meets the ground water Class I beneficial use criterion of 1,000 µmhos/cm and the 250 mg/L recommendation protective of trout eggs in surface water.

CLOSURE *East Boulder Mine* salinity calculations *Days 121-365*				***CLOSURE: Days 121-365:* Of the 737 gpm treated adit water, 284 gpm would be routed to the Boe Ranch LAD storage pond and 453 gpm would be routed to the East Boulder Mine percolation pond**
volume of water routed to **Boe Ranch LAD storage pond** days 121-365	**284** gpm (24 hr)	**100** MG		volume of water in **Boe Ranch LAD storage pond on day 365**
days 121-365: volume of adit water percolated at East Boulder Mine, V_p	87,113 ft^3/d	**453** gpm (24 hr)		volume of treated adit and tailings waters percolated at East Boulder Mine percolation pond
effective average TDS concentration in treated adit waters, C_P	**550** mg/L	858 µmhos/cm		effective average EC of treated land applied adit waters
CLOSURE *East Boulder Mine* Days 121-365: Salts concentration in ground water	531 mg/L	**828** µmhos/cm		projected salts concentration near SP-11 from percolation
CLOSURE *East Boulder Mine* Days 121-365: Salts concentration in East Boulder River below East Boulder Mine	**238** mg/L	372 µmhos/cm		projected salts concentration at EBR-004/004A from percolation of treated adit water

CLOSURE *East Boulder Mine* Days 121-365: Percolation of 453 gpm (24 hr) treated adit water at the East Boulder Mine produces a salts concentration in ground water less than the Class I Beneficial Use criterion of 1,000 µmhos/cm. Percolation of 453 gpm (24 hr) treated adit water at the East Boulder Mine produces a salts concentration in the East Boulder River less than the 250 mg/L recommendation for the protection of trout eggs.

CLOSURE *East Boulder Mine* salinity calculations Days 366-486				***CLOSURE: Days 366-486:* Second 120-day LAD season, 284 gpm would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. Excess waters would be percolated at the East Boulder Mine percolation pond.**
volume of water routed to **Boe Ranch LAD** days 366-486	**284** gpm (24 hr)	**579** gpm (24 hr)		rate that Boe Ranch LAD stored waters are applied at Boe Ranch
based on 2000 to 2008 data from Stillwater east side adit water salts concentration decline after cessation of blasting and mining	**406** mg/L	**634** µmhos/cm		based on 2000 to 2008 data from Stillwater east side adit water salts concentration decline after cessation of blasting and mining
days 366-486: volume of adit water percolated at East Boulder Mine, V_p	87,113 ft^3/d	**453** gpm (24 hr)		volume of treated adit waters percolated at East Boulder Mine percolation pond
CLOSURE *East Boulder Mine* Days 366-486: Salts concentration in ground water	429 mg/L	**669** µmhos/cm		projected salts concentration near SP-11 from percolation of treated adit water
CLOSURE *East Boulder Mine* Days 366-486 Salts concentration in East Boulder River below East Boulder Mine	**207** mg/L	322 µmhos/cm		projected salts concentration at EBR-004/004A from percolation of treated adit water
CLOSURE *East Boulder Mine* salinity calculations Days 487-548				***CLOSURE: Days 487-548:* After the second LAD season, all 737 gpm treated adit water would be routed to the East Boulder Mine percolation pond**
volume of water routed to **Boe Ranch LAD** days 487-548	**0** gpm (24 hr)	0 MG		volume of water in **Boe Ranch LAD storage pond on day 487**
days 487-548: volume of adit water percolated at East Boulder Mine, V_p	141,882 ft^3/d	**737** gpm (24 hr)		adit flow rate at closure
CLOSURE *East Boulder Mine* Days 487-548: Salts concentration in ground water	343 mg/L	**535** µmhos/cm		projected salts concentration near SP-11 from percolation
CLOSURE *East Boulder Mine* Days 487-548: Salts concentration in East Boulder River below East Boulder Mine	**157** mg/L	245 µmhos/cm		projected salts concentration at EBR-004/004A from percolation of treated adit water

CLOSURE *East Boulder Mine* Days 366-548: Percolation of 453 to 737 gpm (24 hr) treated adit water at the East Boulder Mine produces a salts concentration in ground water less than the Class I Beneficial Use criterion of 1,000 µmhos/cm. Percolation of 453 to 737 gpm (24 hr) treated adit water at the East Boulder Mine produces a salts concentration in the East Boulder River less than the 250 mg/L recommendation for the protection of trout eggs.

CLOSURE *Boe Ranch LAD* salt calculations Days 1-120				*CLOSURE: Days 1-120:* **Disposal of 284 gpm treated adit and tailings waters with 579 gpm stored treated adit water at the Boe Ranch LAD so storage pond would be emptied by the end of the 120-day LAD season; excess waters would be disposed at the East Boulder Mine**
depth of aquifer, **D**	15	ft	**737** gpm (24 hr)	adit flow rate at closure
hydraulic conductivity, **k**	0.283	ft/d		KP 2000c Apdx K, Tables
gradient, **i**	0.1			KP 2000c Apdx K, Tables
width of LAD storage pond liner leakage source	10	ft		assume point leakage from LAD pond exists for foreseeable impact to aquifer
width of mixing zone for the LAD storage pond liner leakage, W_2	229	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693	tan 5°		allowed by 17.30.517(d)
length of LAD storage pond liner leakage, L_2	2,500	feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, A_2	3,428	ft^2		D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, V_2	27	ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
Q_2=kiA, **ground water** available for mixing below **liner leakage**	97	ft^3/d	**1,223** µmhos/cm	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_2
concentration of **salts in ambient ground water**; median value from RMW-3a, C_A	**1,025**	µmhos/cm	**657** mg/L	median ambient TDS concentration derived from SMC monitoring data
width of LAD application	3,200	ft		KP 2000c Apdx K, Tables
length of LAD application, L_1	4,500	ft		KP 2000c Apdx K, Tables
width of LAD application ground water mixing area, W_1	3,593	ft		allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, A_1	53,901	ft^2		D * W, allowed by 17.30.517(d)
Q_1=kiA, **ground water** available for mixing below **LAD application area**	1,525	ft^3/d	**1,223** µmhos/cm	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_1
volume of LAD applied; evaporation factor taken, V_1	116,257	ft^3/d	**604** gpm (12 hr)	treated stored water plus adit and tailings waters in the Boe Ranch LAD storage pond; evaporation credit taken
salts concentration in applied LAD adit plus tailings water; assume pivots 30% evaporation, no post plant salt uptake credit, C_1	1,256	µmhos/cm	805 mg/L	effective applied LAD TDS concentration
salts in LAD storage **pond liner leakage** discharge, C_2	879	µmhos/cm	564 mg/L	weighted average adit and tailings TDS concentration in the Boe Ranch LAD storage pond
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593	ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, L_3	4,000	ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, W_3	3,943	ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146	ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674	ft^3/d	**989** µmhos/cm	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_3
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,200	ft^3/d	224 gpm	KP 2000c Apdx K, Tables
assumed **salts concentration of Mason Ditch** , C_3	476	µmhos/cm	**305** mg/L	SMC Monitoring Data, assumed equal to average of EBR-007 and EBR-008

salts concentration in ground water resulting **from applied LAD**	1,256 µmhos/cm	805 mg/L	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_1
salts concentration in ground water resulting **from liner leakage plus applied LAD**	1,256 µmhos/cm	805 mg/L	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration** in ground water for Q_2
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	1,047 µmhos/cm	671 mg/L	projected cumulative salts concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration of salts** in ground water below the Mason Ditch to the East Boulder River, Q_3
CLOSURE Days 1-120 *Boe Ranch LAD* salts concentration in ground water below Mason Ditch, C_d	**1,046** µmhos/cm	670 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
CLOSURE Days 1-120 *Boe Ranch LAD* Salt concentration in East Boulder River below LAD area, non-irrigation season (5.0 cfs)	671 µmhos/cm	430 mg/L	TDS value calculated from EC at 5 cfs; this value is a **26% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE Days 1-120 *Boe Ranch LAD* Salt concentration in East Boulder River below LAD area, irrigation season (2.0 cfs)	780 µmhos/cm	500 mg/L	TDS value calculated from EC at 2 cfs; this value is a **47% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE *Boe Ranch LAD* salt calculations Days 366-486			***Days 366-486:* Second 120-day LAD season, 284 gpm treated adit water would be routed and disposed at greater than agronomic rates with 579 gpm stored waters at the Boe Ranch LAD Area. Excess waters would be percolated at the East Boulder Mine percolation pond.**
salts concentration in ground water resulting **from applied LAD**	907 µmhos/cm	1,415 mg/L	projected salts concentration in ground water below the Boe Ranch LAD area
salts concentration in ground water resulting **from liner leakage plus applied LAD**	907 µmhos/cm	1,416 mg/L	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond using the assumed operational salts concentration in ground water for Q_2
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	792 µmhos/cm	1,235 mg/L	projected cumulative salts concentration in ground water beneath the Mason Ditch using the assumed operational concentration of salts in ground water below the Mason Ditch to the East Boulder River, Q_3
CLOSURE *Boe Ranch LAD* salts concentration in ground water below Mason Ditch, C_d	**794** µmhos/cm	1,239 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
CLOSURE Days 366-486 *Boe Ranch LAD* Salt concentration in East Boulder River below LAD area, non-irrigation season (5.0 cfs)	603 µmhos/cm	386 mg/L	TDS value calculated from EC at 5 cfs; this value is an **11% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE Days 366-486 *Boe Ranch LAD* Salt concentration in East Boulder River below LAD area, irrigation season (2.0 cfs)	658 µmhos/cm	422 mg/L	TDS value calculated from EC at 2 cfs; this value is a **19% increase in salts concentration from ambient TDS** concentrations at EBR-008

CLOSURE *Boe Ranch LAD* Days 120-486: Disposal of 284 gpm (24 hr) treated adit water with 579 gpm stored water produces a salts concentration in ground water less than the Class II beneficial use criterion of 2,500 µmhos/cm. This option produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient TDS concentration of 340 mg/L at EBR-008 and the median TDS concentration of treated adit water, there is no volume of adit water that could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.

Agency-Mitigated Alternative 3C CLOSURE Option 1, 150 gpm: SMC would treat 436 gpm (150 gpm adit water and 284 gpm of tailings waters) at closure to reserve hydraulic capacity to empty the East Boulder Mine tailings impoundment in the first 120-day LAD season. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would maximize treated adit and tailings waters disposal (436 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond) at the Boe Ranch LAD area at greater than agronomic rates. After the 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. No water would be disposed at the East Boulder Mine during the 18-month closure period.

CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations Days 1-486

CLOSURE: First LAD Season: **Days 1-97, disposal of 436 gpm treated adit and tailings waters with 301 gpm stored treated adit water would occur at the Boe Ranch LAD. *Days 98-120,* disposal of 150 gpm treated adit water with 310 gpm stored treated adit water would occur at the Boe Ranch LAD. *Days 121-365*, storage of 150 gpm (24 hr) would occur at the Boe Ranch LAD storage pond until the second LAD season. The second LAD season would occur *Days 366-486,* and 451 gpm treated adit and stored waters would be disposed at Boe Ranch LAD. *Days 487-548,* 150 gpm adit water would be disposed at the mine percolation pond.**

volume in LAD storage pond, assume 8 months stored at 150 gpm	52	MG	**120**	days	time to dewater the **LAD storage pond**
Days 1-120 and Days 366-486 rate to empty **LAD storage pond**	**301**	gpm (24 hr)	602	gpm (12 hr)	**LAD storage pond** dewatering rate
Days 1-97 rate to dewater **East Boulder tailings impoundment**	**286**	gpm (24 hr)	572	gpm (12 hr)	East Boulder **tailings impoundment** dewatering rate
Days 1-548 adit flow rate at closure	**150**	gpm (24 hr)	300	gpm (12 hr)	**adit** flow rate
total pumping rate to dispose of all treated mine waters during 120 day LAD season	737	gpm (24 hr)	**1,474**	gpm (12 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season
volume of the East Boulder Tailings impoundment waters needing disposal	40	MG	737	gpm (24 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season
area available for LAD in section 17, all pivots included	166	ac	97	days	number of days to dewater **East Boulder tailings impoundment** at above rate
land application rate that would empty the LAD storage pond in 97 days	9.7	gpm/ac	**1,615**	gpm (12 hr)	hydraulic load that can be applied and would empty the LAD storage pond in 97 days
rate that adit water is routed to the **Boe Ranch LAD storage pond** days 1-486	150	gpm (24 hr)	150	gpm (24 hr)	rate of disposal at East Boulder Mine during days 487-548 of closure

CLOSURE *Boe Ranch LAD* Days 1-120: Mixing Zone Salinity Calculations

CLOSURE: First LAD Season: Days 1-97, **disposal of 436 gpm treated adit and tailings waters with 301 gpm stored treated adit water would occur at the Boe Ranch LAD. Days 98-120, disposal of 150 gpm treated adit water with 301 gpm stored treated adit water would occur at the Boe Ranch LAD. The aquifer at Boe Ranch has a Class II Beneficial Use.**

depth of aquifer, **D**	15	ft	**550**	mg/L	2000-2008 median **adit** TDS concentration; CES 2008 page 13
hydraulic conductivity, **k**	0.283	ft/d	**897**	mg/L	2002-2006 median **tailings waters** TDS concentration (CES 2008 p 13)
gradient, **i**	0.1		**668**	mg/L	weighted average TDS concentration of **treated mixed adit, tailings, and stored** waters
width of LAD storage pond liner leakage source	10	ft			assume point leakage from LAD pond exists for foreseeable impact to aquifer
width of mixing zone for the LAD storage pond liner leakage, $\mathbf{W_2}$	229	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_2}$	2,500	feet			KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_2}$	3,428	ft^2			D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, $\mathbf{V_2}$	27	ft^3/d	0.14	gpm (24 hr)	KP 2000c Apdx K, Tables
$\mathbf{Q_2}$=kiA, **ground water** available for mixing below **liner leakage**	97	ft^3/d	1,223	μmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground**
concentration of **salts in ambient ground water**; median value from RMW-3a, $\mathbf{C_A}$	1,025	μmhos/cm	**657**	mg/L	KP 2000c Apdx K, Tables
width of LAD application	3,200	ft			KP 2000c Apdx K, Tables

length of LAD application, $\mathbf{L_1}$	4,500 ft		allowed by 17.30.517(d)
width of LAD application ground water mixing area, $\mathbf{W_1}$	3,593 ft		D * W, allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, $\mathbf{A_1}$	53,901 ft^2		allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, **ground water** available for mixing below **LAD application area**	1,525 ft^3/d	1,223 µmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground**
volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	99,318 ft^3/d	**516** gpm (24 hr)	the rate of adit, tailings, and stored waters that would be LAD at the Boe Ranch, evaporation factor applied
salts concentration in applied LAD adit plus tailings water; assume pivots 30% evaporation, no post plant salt uptake credit, $\mathbf{C_1}$	1,488 µmhos/cm	954 mg/L	KP 2000c Apdx K, Tables
salts in LAD storage **pond liner leakage** discharge, $\mathbf{C_2}$	1,042 µmhos/cm	668 mg/L	EC calculated from TDS ;
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
cross sectional area of aquifer between pivots to East Boulder River, $\mathbf{A_3}$	59,146 ft^2		D * W, allowed by 17.30.517(d)
$\mathbf{Q_3}$=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	989 µmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground**
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), $\mathbf{V_3}$	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **salts concentration of Mason Ditch** , $\mathbf{C_3}$	476 µmhos/cm	**305** mg/L	SMC Monitoring Data, assumed equal to average of EBR-007 and EBR-008
salts concentration in ground water resulting **from applied LAD**	1,484 µmhos/cm	951 mg/L	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for $\mathbf{Q_1}$
salts concentration in ground water resulting **from liner leakage plus applied LAD**	1,484 µmhos/cm	951 mg/L	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration** in ground water for $\mathbf{Q_2}$
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	1,182 µmhos/cm	757 mg/L	projected cumulative salts concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration of salts** in ground water below the Mason Ditch to the East Boulder River, $\mathbf{Q_3}$
CLOSURE *Boe Ranch LAD* Days 1-120 EC concentration at in ground water below Mason Ditch, $\mathbf{C_d}$	**1,179** µmhos/cm	756 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
receiving streamflow non-irrigation season, $\mathbf{Q_s}$	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow, non-irrigation season
receiving streamflow irrigation season, $\mathbf{Q_s}$	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow, irrigation season
receiving stream ambient concentration, $\mathbf{C_s}$	530 µmhos/cm	340 mg/L	median value for EBR-008 SMC Monitoring data
discharge volume, $\mathbf{Q_d}$	145,841 ft^3/d	1.7 cfs	
EC concentration at in ground water below Mason Ditch, $\mathbf{C_d}$	1,179 µmhos/cm	757 mg/L	
CLOSURE *Boe Ranch LAD* Days 1-120 East Boulder River TDS concentration during non-irrigation season (5 cfs)	694 µmhos/cm	**445 mg/L**	TDS value calculated from EC at 5 cfs; this value is a **31% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE *Boe Ranch LAD* Days 1-120 East Boulder River TDS concentration during irrigation season (2 cfs)	827 µmhos/cm	**530 mg/L**	TDS value calculated from EC at 2 cfs; this value is a **56% increase in salts concentration from ambient TDS** concentrations at EBR-008

CLOSURE Boe Ranch LAD Days 1-120: Disposal of 436 gpm (24 hr) treated mixed adit, tailings, and stored waters with 301 gpm stored water produces a salts concentration in ground water less than the Class II beneficial use criterion on 2,500 µmhos/cm. This option produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient 270 mg/L TDS concentration in the East Boulder River at EBR-007 and the median TDS concentration of treated adit water, there is no volume of adit water that **could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.**

CLOSURE *Boe Ranch LAD* Days 121-365: Salinity Calculations	***CLOSURE: Days 121-365,*** **storage of 150 gpm (24 hr) would occur at the Boe Ranch LAD storage pond until the second LAD season.**
CLOSURE *East Boulder Mine* Days 121-365 Salinity Calculations	***CLOSURE: Days 121-365*** **No disposal of water would occur at the East Boulder Mine**
CLOSURE *Boe Ranch LAD* Days 366-486: Salinity Calculations	**CLOSURE: The second LAD season would occur *Days 366-486*, and 451 gpm treated adit and stored waters would be disposed at Boe Ranch LAD.**

volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	60,776 ft^3/d	**316** gpm (24 hr)	the rate of adit, tailings, and stored waters that would be LAD at the Boe Ranch, evaporation factor applied
based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining	**406** mg/L	**634** μmhos/cm	based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining
salts concentration in applied LAD adit water; assume pivots 30% evaporation, no post plant salt uptake credit, $\mathbf{C_1}$	580 mg/L	905 μmhos/cm	calculated EC in applied LAD waters
salts concentration in ground water resulting **from applied LAD**	640 μmhos/cm	640 μmhos/cm	**salts concentration** in ground water resulting **from liner leakage plus applied LAD**
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	591 μmhos/cm	**596** μmhos/cm	**CLOSURE *Boe Ranch LAD* EC concentration at in ground water below Mason Ditch, $\mathbf{C_d}$**
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during non-irrigation season (5 cfs)	**345 mg/L**	538 μmhos/cm	TDS value calculated from EC at 5 cfs; this value is a **1% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during irrigation season (2 cfs)	**351 mg/L**	547 μmhos/cm	TDS value calculated from EC at 2 cfs; this value is a **3% increase in salts concentration from ambient TDS** concentrations at EBR-008

CLOSURE Boe Ranch LAD Days 366-486: Disposal of 150 gpm (24 hr) treated adit water with 301 gpm stored water produces a salts concentration in ground water less than the Class II beneficial use criterion on 2,500 μmhos/cm. This option produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient 270 mg/L TDS concentration in the East Boulder River at EBR-007 and the median TDS concentration of treated adit water, there is no volume of adit water that **could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.**

CLOSURE *Boe Ranch LAD* Days 487-548: Salinity Calculations	***CLOSURE: Days 487-548,*** **no disposal would occur at the Boe Ranch LAD**
CLOSURE *East Boulder Mine* Days 487-548 Salinity Calculations	***CLOSURE: Days 487-548,*** **150 gpm adit water would be disposed at the mine percolation pond.**

East Boulder Mine **percolation pond mixing zone imputs**

depth of aquifer, **D**	80 ft		MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	385 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600 ft		MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3		MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5 ft/d		MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400 gpm		MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in aquifer (median at WW-1), $\mathbf{C_A}$	106 mg/L	165 μmhos/cm	EC calculated from TDS; Stillwater Monitoring Data
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977 ft^2		D * W, allowed by 17.30.517(d)
70% Volume of aquifer available for mixing $\mathbf{Q_1}$=kiA_1	76,409 ft^3/d		MPDES Statement of Basis, p.25-26
Volume of adit water percolated at East Boulder Mine, $\mathbf{V_p}$	28,877 ft^3/d	**150** gpm (24 hr)	treated adit water percolated at East Boulder Mine percolation pond
depth of aquifer, $\mathbf{D_2}$	15 ft		allowed by 17.30.517(d)

hydraulic conductivity, **k**	75 ft/d		MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026 ft/ft		MPDES Statement of Basis, p. 25-26
width of source	700 ft		MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900 ft		MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169 tan 5°		allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303 ft^2	**150** gpm (24 hr)	volume of treated adit water
Volume of aquifer available for mixing $\mathbf{Q_2}$=kiA	27,891 ft^3/d	145 gpm (24 hr)	calculation per 17.30.517(d)
based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining, $\mathbf{C_2}$	**634** µmhos/cm	**406** mg/L	projected TDS calculated from EC
upgradient concentration of TDS in aquifer (avg at WW-1), $\mathbf{C_A}$	106 mg/L	165 µmhos/cm	CES 2008 Apdx D, EBoulder Mine TDS Table p 2, central value
receiving stream baseline ambient concentration at EBR-001, $\mathbf{Q_c}$	49 mg/L	76 µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
receiving streamflow, $\mathbf{Q_s}$	423,000 ft^3/d	5.0 cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4
CLOSURE *East Boulder Mine* Days 487-548: Salt concentration in ground water below East Boulder Mine	405 mg/L	**632** µmhos/cm	projected ground water EC in aquifer at SP-11
CLOSURE *East Boulder Mine* Days 487-548 Salt concentration in East Boulder River below East Boulder Mine	**178** mg/L	277 µmhos/cm	projected TDS in East Boulder River at EBR-004/4A

CLOSURE *East Boulder Mine* Days 487-548: Percolation of 150 gpm (24 hr) at the East Boulder Mine is less than the ground water Class I Beneficial Use criterion of 1,000 µmhos/cm and the 250 mg/L recommendation protective of trout eggs in surface water.

Agency-Mitigated Alternative 3C CLOSURE Option 2, 150 gpm: SMC would treat 436 gpm (150 gpm adit water and 286 gpm of tailings waters) at closure to empty the East Boulder Mine tailings impoundment in 79 days. The Boe Ranch LAD storage pond would contain 52 MG of treated adit waters on the first day of the 120-day LAD season. SMC would percolate 200 gpm at the East Boulder Mine to reduce the nitrogen load to the East Boulder River at the Boe Ranch. To empty the Boe Ranch LAD storage pond during the 120-day LAD season, SMC would dispose of 236 gpm from the mine and 301 gpm from the Boe Ranch LAD storage pond at the Boe Ranch LAD area at greater than agronomic rates. After the first 120-day LAD season, 150 gpm of treated adit water would be routed to the Boe Ranch LAD storage pond for disposal during the second LAD season in the 18-month closure period. The 150 gpm of treated adit water would be disposed at the East Boulder Mine days 487 to 548 of the 18-month closure period.

CLOSURE *Boe Ranch LAD* Hydraulic Loading Calculations for Boe Ranch LAD

***CLOSURE: First LAD Season: Days 1-120,* disposal of 181 gpm (24 gpm) treated adit and tailings waters with 301 gpm (24 hr) stored treated adit water would occur at the Boe Ranch LAD and 200 gpm treated adit and tailings waters would be percolated at the East Boulder Mine. *Days 121-365,* storage of 150 gpm (24 hr) would occur at the Boe Ranch LAD storage pond until the second LAD season. The second LAD season would occur *Days 366-486*, and 451 gpm treated adit and stored waters would be disposed at Boe Ranch LAD. *Days 487-548,* 150 gpm adit water would be percolated at the East Boulder Mine.**

volume in LAD storage pond, assume 8 months stored at 150 gpm	52 MG	**120** days	time to dewater the **LAD storage pond**
Days 1-120 and Days 366-486 rate to empty **LAD storage pond**	**301** gpm (24 hr)	602 gpm (12 hr)	**LAD storage pond** dewatering rate
Days 1-120 rate to dewater **East Boulder tailings impoundment**	**231** gpm (24 hr)	463 gpm (12 hr)	East Boulder **tailings impoundment** dewatering rate
Days 1-548 adit flow rate at closure	**150** gpm (24 hr)	300 gpm (12 hr)	**adit** flow rate
Days 1-120 volume of treated water percolated at the East Boulder Mine	**200** gpm (24 hr)	400 gpm (12 hr)	**volume of water percolated** at the East Boulder Mine
total pumping rate to dispose of all treated mine waters during 120 day LAD season	**482** gpm (24 hr)	**965** gpm (12 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season
volume of the East Boulder Tailings impoundment waters needing disposal	40 MG	482 gpm (24 hr)	**total rate** of all treated mine waters needing disposal during 120 day LAD season
area available for LAD in section 17, all pivots included	166 ac	120 days	number of days to dewater **East Boulder tailings impoundment** at above rate
land application rate that would empty the LAD storage pond in 97 days	9.7 gpm/ac	**1,615** gpm (12 hr)	hydraulic load that can be applied at the Boe Ranch LAD

rate that adit water is routed to the **Boe Ranch LAD storage pond** days 1-486	150 gpm (24 hr)	150 gpm (24 hr)	rate of disposal at East Boulder Mine during days 487-548 of closure

Days 1-120: The hydraulic load of 181 gpm (24 hr) treated adit plus tailings waters and 301 gpm (24 hr) Boe Ranch LAD stored waters can be managed at Boe Ranch LAD in one 120 day LAD season. Up to 200 gpm (24 hr) treated adit plus tailings waters would be managed at the East Boulder Mine. Days 121-365: The hydraulic load of 150 gpm (24 hr) treated adit water can be stored at the Boe Ranch LAD over the first fall, winter, and spring for disposal during days 366-486. After day 486, the 150 gpm (24 hr) would be percolated at the East Boulder Mine.

CLOSURE *Boe Ranch LAD* Days 1-120: Mixing Zone Salinity Calculations		***CLOSURE: First LAD Season: Days 1-120,*** **disposal of 181 gpm (24 gpm) treated adit and tailings waters with 301 gpm (24 hr) stored treated adit water would occur at the Boe Ranch LAD and 200 gpm treated adit and tailings waters would be percolated at the East Boulder Mine. The aquifer at Boe Ranch has a Class II Beneficial Use.**	
depth of aquifer, **D**	15 ft	**550** mg/L	2000-2008 median **adit** TDS concentration; CES 2008 page 13
hydraulic conductivity, **k**	0.283 ft/d	**897** mg/L	2002-2006 median **tailings waters** TDS concentration (CES 2008 p 13)
gradient, **i**	0.1	**761** mg/L	weighted average TDS concentration of **treated mixed adit and tailings** waters
width of LAD storage pond liner leakage source	10 ft	**634** mg/L	weighted average TDS concentration of **treated mixed adit, tailings, and stored** waters
width of mixing zone for the LAD storage pond liner leakage, $\mathbf{W_2}$	229 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)
angle of dispersion	0.087421693 tan 5°		allowed by 17.30.517(d)
length of LAD storage pond liner leakage, $\mathbf{L_2}$	2,500 feet		KP 2000c Apdx K, Tables
cross sectional area of aquifer at LAD storage pond liner leakage, $\mathbf{A_2}$	3,428 ft^2		D * W, allowed by 17.30.517(d)
volume of LAD storage pond **liner leakage**, $\mathbf{V_2}$	27 ft^3/d	0.14 gpm (24 hr)	KP 2000c Apdx K, Tables
$\mathbf{Q_2}$=kiA, **ground water** available for mixing below **liner leakage**	97 ft^3/d	1,223 µmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground water** for $\mathbf{Q_2}$
concentration of **salts in ambient ground water**; median value from RMW-3a, $\mathbf{C_A}$	1,025 µmhos/cm	**657** mg/L	EC from 2000-2006 SMC Monitoring Data; TDS calculated from median EC using conversion factor 1 µmhos/cm = 1.56 TDS
width of LAD application	3,200 ft		KP 2000c Apdx K, Tables
length of LAD application, $\mathbf{L_1}$	4,500 ft		allowed by 17.30.517(d)
width of LAD application ground water mixing area, $\mathbf{W_1}$	3,593 ft		D * W, allowed by 17.30.517(d)
cross sectional area of ground water at LAD application, $\mathbf{A_1}$	53,901 ft^2		allowed by 17.30.517(d)
$\mathbf{Q_1}$=kiA, **ground water** available for mixing below **LAD application area**	1,525 ft^3/d	1,223 µmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground water** for $\mathbf{Q_1}$
volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	65,019 ft^3/d	**338** gpm (24 hr)	the rate of adit, tailings, and stored waters that would be LAD at the Boe Ranch, evaporation factor applied
salts concentration in applied LAD: adit, tailings plus stored water; assume pivots 30% evaporation, no post plant salt uptake credit, $\mathbf{C_1}$	1,413 µmhos/cm	906 mg/L	KP 2000c Apdx K, Tables
salts in LAD storage **pond liner leakage** discharge, $\mathbf{C_2}$	1,186 µmhos/cm	761 mg/L	EC calculated from TDS ;
width of aquifer below LAD, includes area of Mason Ditch to East Boulder River	3,593 ft		KP 2000c Apdx K, Tables
length between end of pivots to East Boulder River, $\mathbf{L_3}$	4,000 ft		KP 2000c Apdx K, Tables
width of mixing zone between end of pivots to East Boulder River, $\mathbf{W_3}$	3,943 ft		width of source + (tan 5 * length) allowed by 17.30.517(d)

cross sectional area of aquifer between pivots to East Boulder River, A_3	59,146 ft^2		D * W, allowed by 17.30.517(d)
Q_3=kiA, **ground water** available for mixing **below Mason Ditch to East Boulder River**	1,674 ft^3/d	989 µmhos/cm	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration in ground water** for Q_3
volume of flow from **Mason Ditch** that is assumed to infiltrate (25 % of total), V_3	43,200 ft^3/d	224 gpm (24 hr)	KP 2000c Apdx K, Tables
assumed **salts concentration of Mason Ditch** , C_3	476 µmhos/cm	**305** mg/L	SMC Monitoring Data, assumed equal to average of EBR-007 and EBR-008
salts concentration in ground water resulting **from applied LAD**	1,409 µmhos/cm	903 mg/L	projected salts concentration in ground water below the Boe Ranch LAD area; **assumed to equal the operational salts concentration** in ground water for Q_1
salts concentration in ground water resulting **from liner leakage plus applied LAD**	1,408 µmhos/cm	903 mg/L	projected cumulative salts concentration in ground water below the Boe Ranch LAD storage pond; **assumed to equal the operational salts concentration** in ground water for Q_2
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	1,042 µmhos/cm	668 mg/L	projected cumulative salts concentration in ground water beneath the Mason Ditch; this value will be **assumed to equal the operational concentration of salts** in ground water below the Mason Ditch to the East Boulder River, Q_3
CLOSURE *Boe Ranch LAD* EC concentration at in ground water below Mason Ditch, C_d	**1,041** µmhos/cm	667 mg/L	compliance point in ground water; projected cumulative salts concentration prior to discharge to the East Boulder River
receiving streamflow non-irrigation season, Q_s	432,000 ft^3/d	5.0 cfs	7Q10 value for East Boulder Mine streamflow, non-irrigation season
receiving streamflow irrigation season, Q_s	172,800 ft^3/d	2.0 cfs	7Q10 value for East Boulder Mine streamflow, irrigation season
receiving stream ambient concentration, C_s	530 µmhos/cm	340 mg/L	median value for EBR-008 SMC Monitoring data
discharge volume, Q_d	111,542 ft^3/d	1.3 cfs	
EC concentration at in ground water below Mason Ditch, C_d	1,041 µmhos/cm	668 mg/L	
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during non-irrigation season (5 cfs)	635 µmhos/cm	**407 mg/L**	TDS value calculated from EC at 5 cfs; this value is a **20% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during irrigation season (2 cfs)	731 µmhos/cm	**468 mg/L**	TDS value calculated from EC at 2 cfs; this value is a **38% increase in salts concentration from ambient TDS** concentrations at EBR-008

CLOSURE Boe Ranch LAD Days 1-120: Disposal of 436 gpm (24 hr) treated mixed adit, tailings, and stored waters with 301 gpm stored water produces a salts concentration in ground water less than the Class II beneficial use criterion on 2,500 µmhos/cm. This option produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient 270 mg/L TDS concentration in the East Boulder River at EBR-007 and the median TDS concentration of treated adit water, there is no volume of adit water that could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.

CLOSURE *Boe Ranch LAD* Days 121-365: Salinity Calculations

***CLOSURE: Days 121-365,* storage of 150 gpm (24 hr) would occur at the Boe Ranch LAD storage pond until the second LAD season.**

CLOSURE *East Boulder Mine* Days 1-120: Salinity Calculations

***CLOSURE: Days 1-120,* 200 gpm treated adit and tailings waters would be percolated at the East Boulder Mine. The aquifer at the East Boulder Mine has a Class I Beneficial Use.**

Volume of treated adit plus tailings waters percolated at East Boulder Mine, V_p	38,503 ft^3/d	**200** gpm (24 hr)	rate of treated adit plus tailings waters percolated at East Boulder Mine
Volume of aquifer available for mixing Q_1 + Q_2=kiA	104,300 ft^3/d	**761** mg/L	weighted average TDS concentration of **treated mixed adit and tailings** waters
CLOSURE *East Boulder Mine* Days 1-120: Salt concentration in ground water below East Boulder Mine	441 mg/L	**687** µmhos/cm	assumes no water has been disposed at East Boulder Mine during operations; projected concentrations would be measured at SP-11
CLOSURE *East Boulder Mine* Days 1-120 Salt concentration in East Boulder River below East Boulder Mine	**148** mg/L	230 µmhos/cm	**projected TDS and EC measured at EBR-004/4A**

CLOSURE *East Boulder Mine* Days 1-120: Disposal of 200 gpm treated adit plus tailings waters in the mine percolation pond is projected to produce salts concentrations in ground and surface water that would meet the Class I beneficial use criterion and the recommended TDS concentration for protection of trout egg fertilization.

CLOSURE *East Boulder Mine* Days 121-365 Salinity Calculations			***CLOSURE: Days 121-365*** **No disposal of water would occur at the East Boulder Mine**		
CLOSURE *Boe Ranch LAD* Days 366-486: Salinity Calculations			***CLOSURE: Days 366-486,*** **the second LAD season would occur and 451 gpm treated adit and stored waters would be disposed at Boe Ranch LAD.**		
volume of LAD applied; evaporation factor taken, $\mathbf{V_1}$	60,776	ft^3/d	**316**	gpm (24 hr)	the rate of adit, tailings, and stored waters that would be LAD at the Boe Ranch, evaporation factor applied
based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining	**406**	mg/L	**634**	µmhos/cm	based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining
salts concentration in applied LAD adit water; assume pivots 30% evaporation, no post plant salt uptake credit, $\mathbf{C_1}$	581	mg/L	906	µmhos/cm	calculated EC in applied LAD waters
salts concentration in ground water resulting **from applied LAD**	652	µmhos/cm	653	µmhos/cm	**salts concentration** in ground water resulting **from liner leakage plus applied LAD**
salts concentration in ground water at Mason Ditch resulting **from liner leakage, applied LAD, and Mason Ditch**	583	µmhos/cm	**584**	µmhos/cm	**CLOSURE *Boe Ranch LAD* EC of ground water below Mason Ditch,** $\mathbf{C_d}$
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during non-irrigation season (5 cfs)	**344**	**mg/L**	537	µmhos/cm	TDS value calculated from EC at 5 cfs; this value is a **1% increase in salts concentration from ambient TDS** concentrations at EBR-008
CLOSURE *Boe Ranch LAD* East Boulder River TDS concentration during irrigation season (2 cfs)	**349**	**mg/L**	544	µmhos/cm	TDS value calculated from EC at 2 cfs; this value is a **2% increase in salts concentration from ambient TDS** concentrations at EBR-008

CLOSURE Boe Ranch LAD Days 366-486: Disposal of 150 gpm (24 hr) treated adit water with 301 gpm stored water produces a salts concentration in ground water less than the Class II beneficial use criterion on 2,500 µmhos/cm. This option produces a TDS concentration in the East Boulder River greater than 250 mg/L. Given the ambient 270 mg/L TDS concentration in the East Boulder River at EBR-007 and the median TDS concentration of treated adit water, there is no volume of adit water that could be land applied at a rate that would reduce the ambient TDS concentration of 340 mg/L at EBR-008 below 250 mg/L in the East Boulder River down stream of the Boe Ranch.

CLOSURE *Boe Ranch LAD* Days 487-548: Salinity Calculations			***CLOSURE: Days 487-548*** **, no disposal would occur at the Boe Ranch LAD**		
CLOSURE *East Boulder Mine* Days 487-548 Salinity Calculations			***CLOSURE: Days 487-548,*** **150 gpm adit water would be disposed at the mine percolation pond.**		
***East Boulder Mine* percolation pond mixing zone imputs**			**406**	mg/L	based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining
depth of aquifer, **D**	80	ft			MPDES Statement of Basis, p. 25-26
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26
gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	385	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to wells, $\mathbf{L_1}$	3600	ft			MPDES Statement of Basis, p. 25-26
porosity, ϕ	0.3				MPDES Statement of Basis, p. 25-26
ground water velocity, **v**	6.5	ft/d			MPDES Statement of Basis, p. 25-26
volume of ground water flux available for mixing from MODFLOW	400	gpm			MPDES Statement of Basis, p. 25-26
upgradient concentration of TDS in aquifer (median at WW-1), $\mathbf{C_A}$	106	mg/L			CES 2008 Apdx D, EBoulder Mine TDS Table p 2, central value
angle of dispersion	0.087421693	tan 5°			allowed by 17.30.517(d)
width of mixing zone, $\mathbf{W_1}$	700	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_1}$	55,977	ft^2			D * W, allowed by 17.30.517(d)
70% Volume of aquifer available for mixing $\mathbf{Q_1}$=kiA$_1$	76,409	ft^3/d			MPDES Statement of Basis, p.25-26
Volume of adit water percolated at East Boulder Mine, $\mathbf{V_p}$	28,877	ft^3/d	**150**	gpm (24 hr)	treated adit water percolated at East Boulder Mine percolation pond
depth of aquifer, $\mathbf{D_2}$	15	ft			allowed by 17.30.517(d)
hydraulic conductivity, **k**	75	ft/d			MPDES Statement of Basis, p. 25-26

gradient, **i**	0.026	ft/ft			MPDES Statement of Basis, p. 25-26
width of source	700	ft			MPDES Statement of Basis, p. 25-26
length from perc pond to river, $\mathbf{L_2}$	2,900	ft			MPDES Statement of Basis, p. 25-26
angle of dispersion	0.08742169	tan 5°			allowed by 17.30.517(d)
width of zone, $\mathbf{W_2}$	954	ft			width of source + (tan 5 * length) allowed by 17.30.517(d)
area of mixing zone, $\mathbf{A_2}$	14,303	ft^2	**150**	gpm (24 hr)	volume of treated adit water
Volume of aquifer available for mixing $\mathbf{Q_2}$=kiA	27,891	ft^3/d	145	gpm (24 hr)	calculation per 17.30.517(d)
based on Stillwater east side adit water salts concentration decline data after cessation of blasting and mining, $\mathbf{C_2}$	**406**	µmhos/cm	**261**	mg/L	
upgradient concentration of TDS in aquifer (avg at WW-1), $\mathbf{C_A}$	106	mg/L	165	µmhos/cm	EC calculated from TDS; Stillwater Monitoring Data
receiving stream baseline ambient concentration at EBR-001, $\mathbf{Q_c}$	49	mg/L	76	µmhos/cm	1996-1999 median baseline EC concentration from SMC monitoring data (Hydrometrics 2001)
receiving streamflow, $\mathbf{Q_s}$	423,000	ft^3/d	5.0	cfs	7Q10 at Boulder River USGS gaging station; MPDES Statement of Basis page 4
CLOSURE *East Boulder Mine* Days 487-548: Salt concentration in ground water below East Boulder Mine	183	mg/L	**286**	µmhos/cm	
CLOSURE *East Boulder Mine* Days 487-548 Salt concentration in East Boulder River below East Boulder Mine	**124**	mg/L	194	µmhos/cm	

CLOSURE *East Boulder Mine* Days 487-548: Percolation of 150 gpm (24 hr) at the East Boulder Mine is less than the ground water Class I Beneficial Use criterion of 1,000 µmhos/cm and the 250 mg/L recommendation protective of trout eggs in surface water.

Appendix D — Boe Ranch Supporting Data

This appendix contains maps and tables used in the agencies' effects analysis for the Boe Ranch LAD System Proposed Action Alternative 2C and the Boe Ranch LAD System Agency-Mitigated Alternative 3C.

Table 15. Average Hydraulic Flow Capacity and Management Summary- Operations or Closure

Alternative	Site	Average Flow Capacity[1,2]					Max N-Load[2]	Maximum Volume in Boe Ranch Storage Pond	Comments
		Growing Season gpm	Winter gpm	Total LAD Capacity gpm	Percolation Pond gpm	Total Flow gpm	lb N/d	MG	
No Action - 1C	**East Boulder Mine**								
	LAD 6	**14**	**45**	**24**	**21**	**45**	**2.7**	**N/A**	**Phase Ia, No LAD April, May or October**
	LAD 6, 3 Upper	25	81	44	37	81	4.9	N/A	Winter Snowmaking, Summer LAD
	LAD 6, 3 Upper, 4	36	117	64	53	117	7.0	N/A	Winter Snowmaking, Summer LAD
	LAD 6, 3 Upper/Lower, 4	57	117	72	45	117	7.0	N/A	Add Summer Only Area 3 Lower
	LAD 6, 2, 3 Upper/Lower, 4	68	117	77	43	117	7.0	N/A	All East Boulder LAD Sites
	LAD 6, 2, 3 Upper/Lower, 4	68	117	77	660	737	73.5	N/A	Full Permitted Flow, Additional N Treatment Needed for East Boulder Discharge
Proposed Action - 2C	**Boe Ranch**								
	Upper Boe Ranch	**166**	**166**	**166**	**0**	**166**	**N/A**	**46**	**Phase Ib, No East Boulder LAD**
	Upper Boe Ranch + East Boulder Mine	243	243	243	0	243	1.8	50	If Boe Ranch and all East Boulder LAD Areas are constructed
Agency-Mitigated Action - 3C	**Boe Ranch**								
	Upper Boe Ranch	**162**	**162**	**162**	**0**	**162**	**N/A**	**45**	**Phase Ib, No East Boulder LAD**
	Upper Boe Ranch + East Boulder Mine	239	239	239	0	239	1.8	49	If Boe Ranch and all East Boulder LAD Areas are constructed

NOTES:

Capacities developed from monthly water balances created to illustrate possible water management practices. Winter LAD capacity based on East Boulder Mine Snowmaking Test (SMC, 2004) and 68 inches snow accumulation at 40% snow water equivalent. Growing season flow based on vegetation ET according to Montana Guidelines. Storage Pond capacity is 108 million gallons. Storage pond allows steady flows year round without percolation pond use.

Abbreviations: gpm = gallons per minute, MG = million gallons, lb N/d = pounds nitrogen per day, ET = evapotranspiration, LAD = land application disposal, Max = maximum.

1 Flows computed as gallons per minute for the season or year for comparison with SMC Water Management Plan (SMC, 1998b) = total gallons per year ÷ 1440 minutes per day ÷ days per season or year. Adit flow assumed stable. Growing Season = Jun - Oct (153 days) and is conservative using the high range precipitation. Winter = Nov - Mar (151 days).

2 LAD and Percolate Pond discharge vary on a daily basis. Max. N-Load is the maximum average daily nitrogen load at the East Boulder Mine site assuming the first 250 gpm are treated 5 mg N/L with any flow additional at 10 mg/L. Actual treatment performance shown to provide less than 5 mg/L.

3 Phases represent the Phased development of LAD in the Boe Ranch Alternative (Knight-Piésold. 2002.Stillwater Mining Company East Boulder Project, Water Management Plan Appendix K, Boe Ranch LAD Alternative, Revision 3 (Ref # 31333/18-1). Knight Piesold, Inc. Vancouver, B.C. Canada, updated April 2002.)

Table 17. Summary of Projected LAD Deep Percolation Losses- Soil Water Volume - All Alternatives (1C, 2C, 3B, and 3C)

Location	Site Type	Predicted LAD Percolate Loss								Soil AWC[2]
		Winter	Summer	Total	Leaching Reqm't[1]	Winter	Summer	Total	Leaching Reqm't[1]	
		inches per acre				inches per acre				
Operations		**Low Precipitation**				**High Precipitation**				
East Boulder Mine	Summer Only	2.6	0.3	**2.9**	**1.6**	7.0	1.1	**8.1**	**1.1**	5.7
	Winter & Summer	29.7	0.4	**30.1**	**5.5**	34.1	1.1	**35.2**	**4.9**	5.7
Boe Ranch	Boe Ranch LAD	2.6	0.3	**2.9**	**1.6**	7.0	1.1	**8.1**	**1.1**	7.8
	Boe Ranch Evaporators[3]	0.0	0.0	**0.0**	**0.0**	0.0	0.0	**0.0**	**0.0**	N/A
	Boe Ranch Snow[4]	15.1	0.0	**15.1**	**3.8**	21.8	0.0	**21.8**	**3.7**	7.8
Closure - Proposed Action Alternative 2B[5]		**Low Precipitation**				**High Precipitation**				
East Boulder Mine	Summer Only	2.6	0.3	**2.9**	**1.8**	7.0	1.1	**8.1**	**1.1**	5.7
	Winter & Summer (LAD 6)	29.7	0.4	**30.1**	**6.9**	34.1	1.1	**35.2**	**6.3**	5.7
Closure - Agency Mitigated Action Alternative 3B[5]		**Low Precipitation**				**High Precipitation**				
East Boulder Mine	Summer Only	2.6	0.3	**2.9**	**1.7**	7.0	1.1	**8.1**	**1.1**	5.7
	Winter & Summer (LAD 6)	29.7	0.4	**30.1**	**6.4**	34.1	1.1	**35.2**	**5.8**	5.7
Closure - Proposed Action 2C		**Low Precipitation**				**High Precipitation**				
Boe Ranch	Boe Ranch LAD	2.6	0.3	**2.9**	**1.9**	7.0	1.1	**8.1**	**1.4**	7.8
	Boe Ranch Evaporators[3]	0.0	0.0	**0.0**	**N/A**	0.0	0.0	**0.0**	**0.0**	N/A
	Boe Ranch Snow[4]	15.1	0.0	**15.1**	**4.5**	21.8	0.0	**21.8**	**4.4**	7.8
Closure - Agency Mitigated Action 3C		**Low Precipitation**				**High Precipitation**				
Boe Ranch	Boe Ranch LAD	2.6	0.3	**2.9**	**1.8**	7.0	1.1	**8.1**	**1.3**	7.8
	Boe Ranch Evaporators[3]	0.0	0.0	**0.0**	**N/A**	0.0	0.0	**0.0**	**N/A**	N/A
	Boe Ranch Snow[4]	15.1	0.0	**15.1**	**4.3**	21.8	0.0	**21.8**	**4.2**	4.3

NOTES:

Estimated deep percolation volumes for LAD at East Boulder Mine and Boe Ranch. Based on MT LAD Guidelines operations in summer, approximately 68 inches depth for snowmaking in winter. Summer Flow is May or June - October. Snow melt is assumed April and May. Winter snowmaking is November through March. Predictions are for average Low and average High precipitation years (Knight-Piesold, 2000).

Abbreviations: LAD = land application disposal; Reqm't = requirement; gpm = gallons per minute.

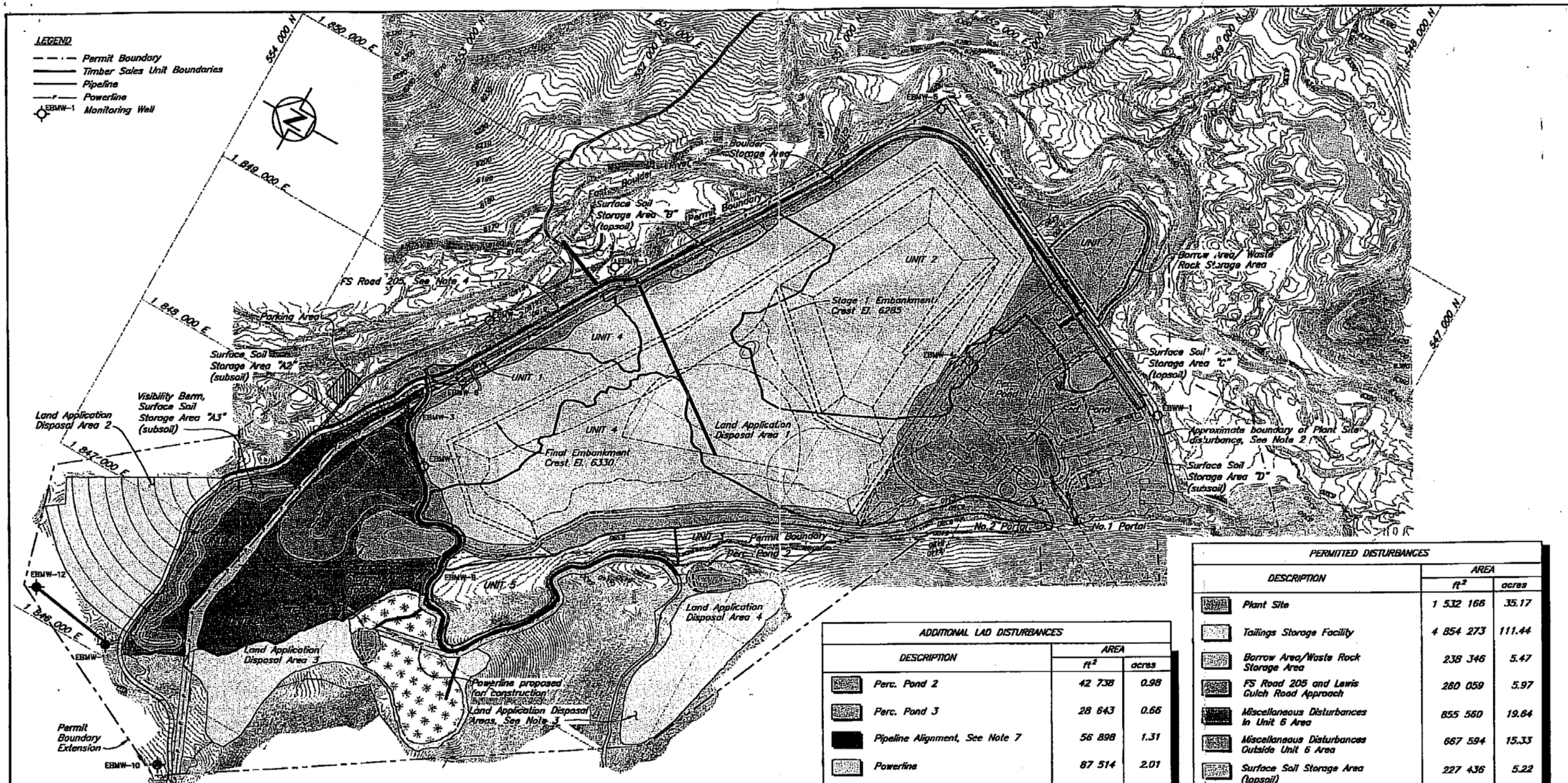
1 Leaching requirement computed from average electrical conductivity of applied mine water. Represents amount of deep percolation needed to prevent salts accumulation and maintain soil salinity less than 2 mmhos/cm (Ayers and Westcot, 1985).

2 Soil available water holding capacity shown for perspective compared to leaching requirement and deep percolation.

3 Evaporators operate over the pond so there is no percolate loss or load to be calculated.

4 Deep percolation from snowmelt includes natural and artificial snow and assumes 30% of artifical snow will runoff into storage pond.

5 Alternative 3B is in place because there were no plans under no action for East Boulder Mine Closure. Includes up to 18 months to empty Tailings Impoundment (51 gpm) + adit flow to LAD and percolation pond up to 250 gpm.



ADDITIONAL LAD DISTURBANCES		
DESCRIPTION	AREA ft²	AREA acres
Perc. Pond 2	42 738	0.98
Perc. Pond 3	28 643	0.66
Pipeline Alignment, See Note 7	56 898	1.31
Powerline	87 514	2.01
LAD 2 Pivot Disturbance	22 824	0.52
LAD Monitoring Wells and Road	11 230	0.26
	TOTAL	5.74

PERMITTED DISTURBANCES		
DESCRIPTION	AREA ft²	AREA acres
Plant Site	1 532 166	35.17
Tailings Storage Facility	4 854 273	111.44
Borrow Area/Waste Rock Storage Area	238 346	5.47
FS Road 205 and Lewis Gulch Road Approach	260 059	5.97
Miscellaneous Disturbances In Unit 6 Area	855 560	19.64
Miscellaneous Disturbances Outside Unit 6 Area	667 594	15.33
Surface Soil Storage Area (topsoil)	227 436	5.22
Surface Soil Storage Area (subsoil)	595 386	13.67
Powerline	455 179	10.45
	TOTAL	222.36

NOTES

1. Topography developed by scanning original 1988 drawings and adjusting to fit mine grid and survey control points. Grid system shown is SMC 6000. Additional topography for proposed permit boundary extension was surveyed in 1998.
2. Layout of Plant Site provided by Kilborn, February 1999.
3. Land Application Disposal (LAD) areas, Perc. Ponds and pipeline alignments provided by MSE/HKM. LAD areas are not additional disturbances. Pipeline alignments only account for additional disturbances outside of areas disturbed by FS Road 205 and Lewis Gulch Road approach.
4. FS Road 205 and Lewis Gulch road locations and reconstruction details provided by Morrison Maierle.
5. The Plant Site disturbance area includes 3.21 acres that extends onto the Tailings Storage Facility. This is not included in the disturbance area for the Tailings Storage Facility.
6. Monitoring Wells EBMW-10, 11, and 12 to be installed.
7. Disturbances for pipeline alignment are based on a width of 12 feet.

Scale 300 0 300 600 900 1200 1500 Feet

NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
F	4MAY99	TIMBER SALES UNIT BOUNDARIES ADDED	KDE	DSR	DAH	KDE
E	8APR99	RE-ISSUED FOR INFORMATION	KDE	DSR		
D	18APR99	RE-ISSUED FOR INFORMATION	KDE	DSR		
C	17MAR99	RE-ISSUED FOR INFORMATION	KDE	DSR		
B	16MAR99	RE-ISSUED FOR INFORMATION	KDE	DSR		
A	12MAR99	ISSUED FOR INFORMATION	KDE	DSR		

REVISIONS

DRG. NO.	DESCRIPTION
—	—

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

STILLWATER MINING COMPANY

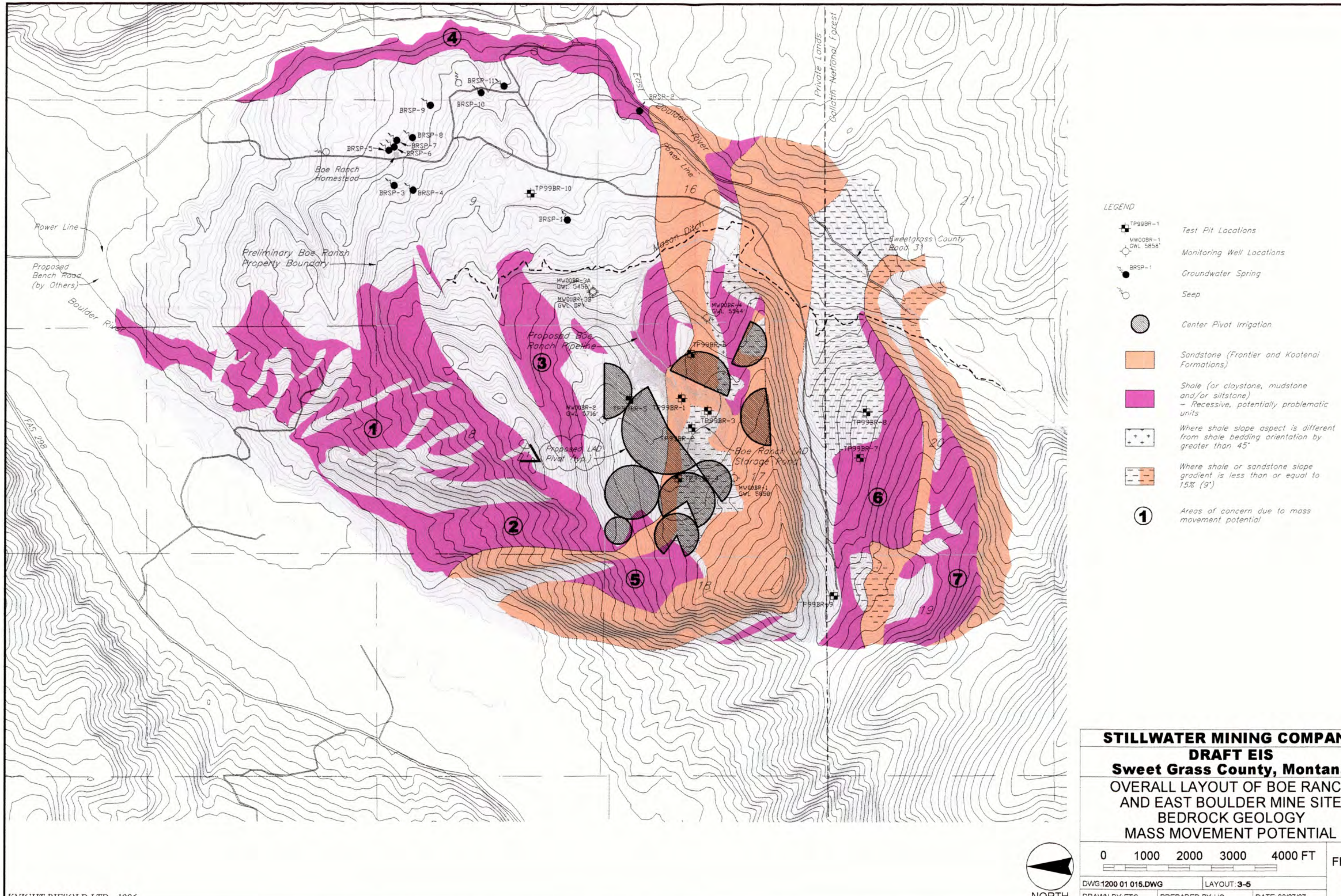
EAST BOULDER PROJECT

PERMITTED SITE DISTURBANCES

DESIGNED KDE | CHECKED | DRAWN DSR | APPROVED

Knight Piésold CONSULTING

SCALE AS SHOWN | REVISION F | DRAWING NO. 31333-8-010



STILLWATER MINING COMPANY
DRAFT EIS
Sweet Grass County, Montana

OVERALL LAYOUT OF BOE RANCH AND EAST BOULDER MINE SITE BEDROCK GEOLOGY MASS MOVEMENT POTENTIAL

FIGURE **3-5**

DWG: 1200 01 015.DWG | LAYOUT: 3-5
DRAWN BY: ETC | PREPARED BY: HS | DATE: 02/27/07

KNIGHT PIESOLD LTD., 1996