

GROUND WATER QUALITY DISCHARGE PERMIT

STATEMENT OF BASIS

Kennecott Bingham Canyon Mine and Water Collection System

Purpose

This is the second renewal of the Bingham Canyon Mine and Leach permit, which was initially issued in 1999. Modifications of the original permit include adoption of permit limits for all wells covered by the permit (see monitoring approach), inclusion of a number of source control measures most importantly the cessation of active leaching, source control and contaminant cleanup for the Dry Fork area and adoption of a mine closure plan.

Description of Facility

Bingham Canyon Mine - The Kennecott Utah Copper Bingham Canyon Mine operations are located in the Oquirrh Mountains approximately 18 miles southwest of Salt Lake City, Utah. This mine produces copper and other metals that are currently extracted using an open pit method of mining. Open pit operations have been conducted at this site for over 100 years. Facilities included in the mine operations include the truck maintenance shops, warehouses, and mine support activities.

Waste Rock Dumps - The waste rock associated with this mining operation has been placed adjacent to the open pit on the slopes of the Oquirrh Mountains. The waste rock disposal areas consist of over 4 billion tons of waste rock located in two principal areas. These two areas are referred to as the East Side and West Side waste rock dumps. The waste rock consists of low concentrations of sulfide mineralization and trace metals in an intrusive host rock, limestone, and quartzite.

Active leaching of the waste rock dumps ended in October 2000. Previously, parts of the dumps were leached by recycling water collected at the base of the dumps and placing it back on top of the waste rock. Although active leaching, i.e. recycling the collected water, has stopped, poor quality meteoric water is still collected in the water collection system at the base of the dumps. Other portions of the dumps were not actively leached but do generate acidic drainage by virtue of natural precipitation. This water is collected and used as process water or discharged as allowed under the UPDES permit (#0000051).

The collection system for the East Side dumps consists of a series of 26 cut-off walls (Dwg. 454-T-0118). To augment the effectiveness of each cut-off wall, which were constructed in each drainage down gradient of the waste rock dumps, toe and French drains were installed in the formerly leached area from Bluewater 1 to the Copper drainage. The collected water is conveyed via HDPE pipelines to South Area Water Services (SAWS) for metal extraction or to the Large Reservoir. Following the extraction of copper the collected water is stored in the lined and permitted (UGW 350006) Bingham reservoirs and used as process water in the tailings line.

Leach water was applied to the Dry Fork waste rock dump until 1999. In addition to the cut-off wall in lower Bingham Canyon, groundwater extraction wells are located in Bingham Canyon and Dry Fork. These wells are designed to either intercept groundwater impacted by the historic leach water applications or to capture clean water before it is impacted by waste rock.

SXEW Operations - Kennecott has conducted a pilot scale Solvent Extraction/Electrowinning (SXEW) project on a lined and monitored area on the Dry Fork dump. The pilot plant was decommissioned in 1999. Current plans as of 2009 include use of the leach pad on the Dry Fork dump for heap leach test work. Pregnant leach solution is then piped to the Process Plant at the mouth of Bingham Canyon. Efforts to complete a full scale SXEW facility at the mouth of Bingham Canyon began in 2008 and were put on hold in 2009. The extent of SXEW operations is dependent on a variety of future market conditions.

Bluewater Repository - The Bingham Canyon Mine and Water Collection System ground water quality discharge permit incorporates the previous ground water permit issued for the Bluewater Repository. Each segment of the repository includes a leachate collection system that routes flows to the leach collection pipeline. The Bingham Canyon Mine and Water Collection System ground water quality discharge permit includes pertinent portions of the prior Bluewater Repository ground water quality discharge permit. .

Site Hydrogeology

Tertiary volcanic rocks are the primary stratigraphic unit that underlies the majority of the East Side waste rock dumps. There is a thin layer of unsaturated alluvial and colluvial material under parts of the waste rock dumps. Beneath the Tertiary volcanics and subcropping beneath portions of the waste rock dumps are quartzites and limestones of Paleozoic age. The Paleozoic bedrock beneath the Dry Fork waste rock dumps area is highly fractured and is more permeable than the bedrock beneath the other waste rock dumps. Beneath most of the dumps, water tends to perch at the waste rock/bedrock contact, but in the Dry Fork area some of the leach water infiltrated into the underlying bedrock during leaching operations. To the east of the waste rock disposal areas, the Tertiary volcanics and Paleozoic sediments are covered by Plio-Pleistocene alluvial deposits. These deposits thicken to the east to form the principal aquifer in the Southwest Salt Lake Valley¹.

The Salt Lake Valley is generally characterized as having a shallow unconfined and a principal confined aquifer system. Confining layers are generally not present or discontinuous near the base of the mountains and are more pronounced towards the center of the valley². Except for a thin veneer of alluvial material in the area from the Copper drainage northward to the Bluewater drainage, Kennecott's East Side waste rock dumps and water collection system are located on top of Tertiary volcanic rocks that transition to the alluvial aquifer system to the east of and down gradient from the collection system. Based on mapping of recharge areas completed by the U.S. Geological Survey, Kennecott's former East Side leaching operations are immediately adjacent to the primary recharge area for the west side of the Salt Lake Valley².

Background Water Quality

Water quality in the principal aquifer adjacent to the East Side waste rock dumps is somewhat variable. Effects of historic mining practices are evident in some areas. Generally the water quality down gradient of the non-leached waste rock dumps has a total dissolved solids (TDS) value between 500 mg/l and 3,000 mg/l making it class II water. There are a few areas that exhibit class I water with TDS values less than 500 mg/l. In areas impacted by acidic waters, a typical water quality signature includes class III water with elevated values of TDS, sulfate, magnesium, copper, cadmium and zinc.

Basis for Permit Issuance

Kennecott has proposed a discharge minimization approach coupled with source control for this ground water discharge permit. Discharge minimization will be achieved through the use of an upgraded cut-off wall/collection system along the East Side dumps and a cutoff wall combined with extraction wells in the Dry Fork area. A major source control step was completed with the cessation of active leaching in 2000.

Control Technology - A typical cut-off wall configuration for the East Side waste rock dumps is depicted on drawing 451-T-9080 (attached). Cut-off walls have been placed in all principal drainages along the perimeter of the East Side waste rock dumps. The site for each wall was excavated to bedrock to allow the wall to be keyed into bedrock. Along with the concrete cut-off wall, a collection pond immediately upstream of the wall is installed. In the Bluewater 1 south to the Copper drainage the collection ponds upstream of the walls are lined with HDPE material and seepage collection trenches extend from each side of the wall to the top of the local drainage catchment. These trenches are excavated to bedrock, clay lined, and have a perforated collector pipe laid in a filter-cloth enclosed gravel drain on top of the clay liner. The trenches augment interception of subsurface flow in the thin veneer of alluvial material and direct the water to the collection pond behind the cut-off wall. Waters collected at a cut-off wall are directed via HDPE pipeline to the collection system.

The pipelines for the East Side collection system lie adjacent to a concrete lined canal, which acts as a backup for conveyance of the collected water. The canal is to be used for maintenance and high flow situations from storm events or snow melt events that result in flow volumes that exceed the capacity of the pipeline. The canal is used as a secondary containment structure for water piped from Bingham Tunnel and/or Lark Shaft to the large Reservoir and/or the Waste Water Disposal Pump Station. The canal can also be used for upset conditions such as a pipeline break. The concrete ditch is not used for routine conveyance of mine impacted meteoric waters.

Flows from the Dry Fork waste rock dump and other West Side dumps that drain into the Bingham Canyon are contained and collected as follows (see DWQ 454-T-0415 and 454-T-0416):

1. Two extraction wells (Mid Valley and Picnic Flats) are maintained in upper Dry Fork Canyon to capture water before it contacts the waste rock dumps and underlying contaminated groundwater. Water is collected by the Mid Valley well (COP2701) and the Picnic Flats well (COG1172) and routed to the Copperton Concentrator for use as process

water. Enough water is extracted from the Mid Valley well on an annual basis to keep the alluvium and shallow bedrock surrounding the wells substantially dewatered.

2. The Bingham Creek cut-off wall was constructed at the mouth of Bingham Canyon in 1995-96 to collect subsurface alluvial flow in the Bingham Creek drainage. The scale of this wall is considerably larger than other cut-off walls constructed for the East Side dumps. The depth of the excavation to bedrock was in excess of 100 feet. The wall is over 300 feet across at the top with a maximum thickness of 24 feet at its base. Flows collected by the wall are ultimately sent to the tailings pipeline.

3. A pump-back well (ECG1185) has been installed in the Copperton channel, a small alluvial channel that underlies the town of Copperton. Subsurface flows, estimated at 30 to 40 gpm, in this channel do not report to the Bingham Creek cut-off wall. Flows captured in this channel are ultimately sent to the tailings pipeline.

4. An alluvial extraction well (ECG2787) has been installed in Bingham Canyon approximately 4700 feet up gradient from the cut-off wall. This well is located immediately below the toe of the planned lowest waste rock dump within the canyon. Enough water is extracted from this well on an annual basis to keep the alluvium surrounding the well substantially dewatered. This pumping will continue until sulfate concentrations in the well decline to below 5000 mg/L, at which point extraction may be discontinued and the well will only be used as an informational monitoring point. However, if sulfate concentrations in the well exceed 5000 mg/L again pumping will be resumed.

5. An alluvial extraction well (Curtis Springs or K83) has been installed in Bingham Canyon about 2400 feet up gradient from the cut off wall. The well is targeted to be pumped at an average annual rate of 100 acre-feet per year (approximately 80gpm) on a three year rolling average. The well screen is at 46 ft to 96 ft below ground surface through alluvium and if the water level falls to the pump intake level at 92 feet, the extraction rate would be decreased to match inflow to the well. In addition, consideration will be made to decrease the pumping rate should additional pumping wells installed upgradient of K83 impact the ability of K83 to produce 100 acre-feet per year on a three year rolling average. In such case, the average annual rate of both wells combined will average 100 acre-feet per year. This pumping will continue until sulfate concentrations in the well decline to below 5000 mg/L, at which time extraction may be discontinued and the well will be used as an informational point. However, if sulfate concentrations in the well exceed 5000 mg/L again then pumping will be resumed.

The Bingham Canyon Mine pit acts as a large ground water sink in this area of the Oquirrths. On average, Kennecott removes water from the pit on a continuous basis at a rate of approximately 1,000 gallons per minute. There are several water quality issues related to mine closure that are addressed in the closure plan. The majority of these issues appear to be related to pit water accumulation and drainage as well as flows from a variety of tunnels associated with mine operations.

Monitoring Approach – A monitoring well network of 43 wells, 36 on the eastside (Figure

454-T-0118 and Table 1) and 7 in the Dry Fork area (Figure 454-T-0415 and Table 2), is utilized for compliance monitoring of the Bingham Canyon Mine and Water Collection System. In addition, wells listed in Table 3 will be used for additional informational monitoring on the eastside and within Dry Fork/Bingham Canyon area. Prior to 2004, only 15 wells were used for compliance monitoring. In 2004, 30 wells were added to the existing network of compliance monitor wells. One of the original compliance monitor wells (ECG940) was removed since the well has never shown mine-impacts over the past ten years and water quality in the vicinity of the well is considered Class IA pristine drinking water. The primary objective of this line of compliance wells is to measure any water quality impact that may occur to the principal aquifer system from Kennecott operations. Permit limits are based on monitoring the effectiveness of the upgraded cut off walls, source controls and collection system.

Where possible, Eastside well locations were selected to provide completions in the alluvial aquifer system to the east of the waste rock disposal areas where at least 50 to 100 feet of saturated thickness exists. In the southern portion of the East Side waste rock disposal area and areas immediately down gradient of the cut off walls; compliance monitor wells are completed in bedrock because no saturated alluvial deposits exist.

The seven compliance wells located in the Dry Fork/Bingham Canyon area (Table 2) are screened against bedrock and are sited to confirm that contamination is not migrating out of the Dry Fork/Bingham Canyon area via bedrock flow paths. These compliance monitor wells are all located up gradient of the Bingham Canyon cutoff wall.

Permit limits were established in 1999 for the original 15 compliance wells, and in 2004 for the additional compliance wells for pH, total dissolved solids, sulfate, dissolved cadmium, copper and zinc (Table 1). These parameters were selected as good indicators of mine impacted water. The permit limits established in 1999 were based on monitoring data collected over a period of 4 to 5 years, while limits established in 2004 were based on monitoring data collected over ten years.

Permit limits will not be established for the eight Dry Fork compliance wells (Table 2) until they have been re-established after waste rock disposal activities in the area are completed. Permit limits for these wells will be based upon 12 quarterly samples, collected as the wells are re-established.

Two of the original compliance monitor wells, ECG938 and ECG1189, have shown very little to no mining impacts. If after an additional five years of compliance monitoring, the wells continue to show relatively no change in water quality, KUCC may propose removing these wells from the list of compliance monitor wells.

Kennecott has proposed using a well (ECG1184) located at the mouth of Butterfield Canyon as the compliance well for the waste rock dumps that are tributary to Butterfield Canyon. This well would act in place of the five compliance wells completed in bedrock located in the Butterfield Canyon vicinity. The proposed well is completed in alluvial materials and would require a mass balance approach to identify waste rock influences from stream flows, tunnel flows, and un-affected bedrock ground water flow influences. The Division has not included this approach in the current permit.

Kennecott has the option to collect data and make a demonstration that this approach is viable although the permit does not require this.

Operational monitoring for this permit includes flow and quality sampling of mine impacted waters from the collection system, tunnel flows, leachate from repository sumps, seeps (if present), informational wells and extraction wells.

One of the technical issues associated with the monitoring well system is the ability to distinguish contamination that is historical in nature from contamination that has a recent origin. Prior to the installation of the upgraded cutoff wall system in 1994-1996, the old cutoff wall system was in operation. The old cutoff wall system was not as effective and loss of leach waters was significantly greater. In addition, the velocity of ground water in the bedrock material is quite slow based on numerous tests conducted by Kennecott. It is very likely that the contaminated ground waters present in the vicinity of some monitoring wells is from a time frame that precedes the installation of the upgraded cutoff wall system. The monitoring well system will need to distinguish between historic contamination and more recent contamination that would indicate the upgraded cutoff wall system is not performing properly. Kennecott completed a study to age date and identify the source of ground waters in the bedrock system to provide clarification on this issue.

Basis for Specific Permit Conditions

1. *Bluewater Repository* – The Bingham Canyon Mine and Water Collection System permit incorporates the previous groundwater discharge permit for the Bluewater Repository. Two standing conditions from that permit are needed to address future construction of the clay liner or clay cap. The first item requires KUCC to comply with the Quality Assurance/Quality Control plan approved for the Bluewater Repository groundwater discharge permit. The second item requires an “As Built” report that documents how construction conformed to the approved design and QA/QC requirements be submitted within 60 days of final completion of new segments of the cap or liner.
2. *Permit Renewal Application Items* - To assist in permit renewals every five years, this condition requires Kennecott to submit a water quality summary of the previous data collected for operational sites and compliance monitoring wells and surface water sites. The annual ground water report submitted on an annual basis fulfills this requirement. The report will include an analysis of trends and changes in water quality over the life of the permit.
3. *Closure Plan* - Acidic drainage from the waste rock dumps will continue to be generated from meteoric water long after the Bingham Canyon Mine ceases operations. In addition, ground water will inundate a portion of the pit and may flow out of the pit via tunnels etc. A conceptual closure plan has been submitted to the DWQ to address the water quality related closure issues associated with the mine and waste rock disposal areas (Bingham Canyon Mine 2003 Reclamation and Water Management Plan). The conceptual closure plan will be updated and submitted for

review in conjunction with major changes and revisions. A final closure plan is due one year prior to final closure. Included in the initial closure plan will be preliminary designs and a schedule to minimize infiltration of meteoric water through the waste rock and low-grade ore dumps.

4. *SXEW Plans and Specifications* - Kennecott is currently conducting a pilot scale leaching program on a lined portion of the Dry Fork Waste Rock Dump as well as pilot scale solvent extraction/electrowinning. The original pilot scale Solvent Extraction/Electrowinning plant associated with the heap leach piles was discontinued in the late 1990's and planned for demolition. Plans to construct and operate a full scale SXEW facility at the mouth of Bingham Canyon near the SAWS administrative buildings began in 2008 but have been placed on hold due to economic conditions. The plans and details for the future SXEW operations were submitted to UDEQ in 2008. However, this condition is included in the Bingham Canyon Mine and Leach Collection System Ground Water Quality Discharge Permit to require Kennecott to provide detailed plan modifications and specifications for any future SXEW operations. Plans and specifications should be submitted 180 days prior to the planned start of construction of these facilities. The plans and specifications must be approved by the Executive Secretary.

5. *Contingency for Installation of a Bedrock Extraction Well in Bingham Canyon* – If bedrock compliance monitor wells K93 and ECG2789A&B at the mouth of Bingham Canyon begin to show signs of contaminant plume migration KUC will refer to Section 4 of Appendix G of permit UGW350010 for guidance on how to proceed. Installation of a bedrock extraction well at the base of the lower Bingham Canyon dumps to combat any further migration of a deep bedrock plume will be assessed by the Utah Division of Water Quality (UDWQ) and KUC. KUC and UDWQ will refer to Section 4 of Appendix G of this permit as well as compliance limits established for the wells as per the accelerated sampling program outlined in Table 2 for guidance regarding pumping well installation.

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1. Bingham Canyon Mine East Side Collection Monitoring Network Ground Water Discharge Permit Application. Kennecott Utah Copper, April 1996.

 2. Hydrogeology of recharge areas and water quality of the principal aquifers along the Wasatch Front and adjacent areas, Utah. U.S. Geological Survey Water Resources Investigations Report 93-4221. P.B. Anderson, D.D. Susong, S.R. Wold, V.M. Heilweil, and R.L. Baskin, 1994.

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