

**GROUND WATER QUALITY DISCHARGE PERMIT UGW350011
STATEMENT OF BASIS**

Kennecott Utah Copper
Tailings Impoundment
Magna, Utah

January 2011

Facility Description and Background

The Tailings Impoundment complex is located in Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 of Township 1 South, Range 3 West and Sections 5, 6, 7, 8, 9, 17, 18, 19, and 20 of Township 1 South, Range 2 West. The Tailings Impoundment has operated since 1906 for the storage of tailings from concentrators processing ore from the Bingham Canyon mine, and has undergone numerous changes and expansions to accommodate the volume of materials. The original 1350-acre impoundment was located in the western portion of the Magna impoundment area. Around 1914, the original impoundment was enlarged to the east by approximately 1,466 acres. By the early 1990's, the footprint of the South Impoundment had reached approximately 5700 acres with a height of over 220 feet, storing 1.5 billion tons of tailings. The South impoundment has completed its operational life and no longer receives tailings materials. In 1995, Kennecott added approximately 3,300 acres adjacent to and north of the existing impoundment to enable operations of the Bingham Canyon Mine to continue for approximately another 20 years. This expansion also allowed for the seismic upgrade of the impoundment. Beginning in 1999, tailings deposition began transitioning from the South Impoundment to the North Impoundment. The current discharge into the North Impoundment is approximately 170,000 tons per day of tailings from the Copperton Concentrator.

Site Hydrogeology

Three aquifer systems exist in the vicinity of the Tailings Impoundment: the Bedrock Aquifer system associated with the Oquirrh Mountains, the confined Principal Aquifer, and the unconfined Shallow Aquifer. The bedrock aquifer is comprised of highly fractured Paleozoic carbonate rocks. Recharge to this system is principally from precipitation on the mountains to the south. The flowpath through this aquifer moves from the fractured bedrock into the Principal and Shallow Aquifers or is discharged as spring water along bedrock contacts at the base of the mountains. Water quality of the bedrock aquifer is generally Class II ground water (TDS less than 2,000 mg/l). There are occasional arsenic and selenium values that exceed ground water quality standards in the bedrock aquifer. The high selenium values are attributable to localized impacts from past Refinery operations.

The Principal Aquifer is a confined system which includes a gravel zone and lacustrine deposits. The gravel zone was most likely derived from the local mountains during an extensive low lake cycle. Many high-yield water supply wells near the Oquirrh Mountains are completed in the gravel zone of the Principal Aquifer. The lacustrine zone consists of clay, silt and interbedded fine sand. Ground water flow direction for the Principal Aquifer is north toward the Great Salt Lake. Except directly beneath the existing Tailings Impoundment, measured water levels in the principal aquifer are above ground level at locations north of Highway 201 indicating an upward hydraulic gradient throughout the vicinity of both impoundments. A ground water mound, with downward vertical gradients, exists directly beneath the impoundments. Ground water quality in the Principal Aquifer is generally better than the Shallow Aquifer, with TDS values ranging from 700 to 40,000 mg/l. The higher TDS values correlate with proximity to the Great Salt Lake. Concentrations of arsenic, selenium, and cadmium in excess of Utah Ground Water Quality Standards have been observed in the Principal Aquifer.

The Shallow Aquifer system consists of interbedded lacustrine Bonneville Clay, silt, and fine sand. The exact depth of this system varies but is approximately the upper 35 to 50 feet of saturated sediments. The potentiometric surface for the Shallow Aquifer system depicts lateral flow in a northerly direction toward the Great Salt Lake. An upward hydraulic gradient from the underlying Principal Aquifer exists for the majority of wells completed in the Shallow Aquifer system. A ground water mound exists directly beneath the Tailings Impoundment with downward vertical gradients indicating a potential for discharge of tailings water into the shallow system. Ground water quality in this system varies markedly from the contact with the bedrock system on the south showing relatively high quality waters with TDS values around 1,000 mg/l to TDS values exceeding 200,000 mg/l in the vicinity of the Great Salt Lake. Concentrations of arsenic, selenium, and cadmium in excess of Utah Ground Water Quality Standards have been observed in the Shallow Aquifer.

Facility Operations

South Impoundment - Tailings deposition into the South Impoundment ceased in October 2002. Draindown water from the South Impoundment is collected in the clarification canal and toe drains that have been constructed around the perimeter of the impoundment. When necessary, the water in the clarification canal can be discharged through UPDES permitted discharge points. Some seepage from the impoundment enters the shallow aquifer system. Kennecott estimates this amount at 620 gallons per minute, however, this will gradually decrease over time due to the establishment of a vegetative evapotranspiration cover.

A sedimentation pond has been constructed east of the southeast corner of the South Impoundment to allow for further clarification of the draindown water to reduce total suspended solids on an as needed basis prior to return of water to the process circuit. The Sedimentation Pond is also underlain by the low permeability Bonneville Clay.

The Diving Board area is located immediately south of State Road 201 and west of 9180 West. This area is a small earthen impoundment designed to retain tailings discharges resulting from scheduled shutdowns and temporary upsets. Drainage from this area is collected via a ditch and channeled to the clarification canal. Accumulated tailings are periodically excavated and transferred from the Diving Board area to the Tailings Impoundment. Past releases of process water to this area have resulted in dissolved arsenic levels of in the shallow groundwater that exceed the Utah ground water quality standard. The upward hydraulic gradient has protected the intermediate aquifer from arsenic degradation.

North Impoundment - The North Impoundment is underlain by the Bonneville Clay, a thick laterally extensive low-permeability lacustrine deposit. This contiguous stratum represents the top layer of a several hundred foot thick sequence of fine-grained lacustrine sediments.

Tailings are deposited into the North Impoundment in slurry form via a single point discharge system that deposits tailings into the interior as well as through two main discharge facilities (cyclones). Cyclones direct overflow (fine-grained material) to the interior and the underflow (coarse material) to the embankment. Both blanket and finger drains composed of crushed slag were constructed in the base of the embankment to promote horizontal seepage of process water under the embankment and into the perimeter toe drain collection ditch. This water is recycled back to the Copperton Concentrator. Water is also removed through a decant pond. When necessary, the water can be discharged through a UPDES permitted discharge point.

Construction of the North Impoundment embankment is proceeding in advance of tailings deposition. There are insufficient tailings available on an annual basis to construct the full width of the north embankment, therefore it is being constructed in two phases. Phase 1 includes the Zone A embankment that is being constructed over a composite slag drainage blanket. In 2005, construction of Phase 2 was initiated to construct Zones B&C over a system of slag finger drains tied into the drainage blanket to facilitate dewatering of the tailings. Phase 1 is anticipated to be completed by 2016 when Phase 2 construction essentially covers and expands beyond the Zone A embankment. Closure of the North Impoundment will be conducted similar to the South Impoundment

Bevill-Excluded Wastes - Congress granted an exclusion from the requirements of the hazardous waste program for certain mining wastes. This exclusion, known as the Bevill Amendment, identifies solid wastes from the extraction, beneficiation, and processing of ores and minerals and excludes them from the requirements of the EPA Hazardous Waste Program. The basis of this exclusion was that these wastes are characterized by high volume, low hazard, and that management as hazardous waste may be inappropriate. On June 23, 1990 EPA issued a final rule that listed 20 mineral processing wastes that are excluded. Three of the ten inflows to the Tailings Impoundment are included under this Bevill exclusion and therefore are not subject to the requirements of the Hazardous Waste Program.

Waste Stream Inflows - Waste stream inflows authorized under this permit for placement in the Tailings Impoundment are:

1. Copper tailings from the Copperton Concentrator;
2. Slag tailings from the slag concentrator at the Smelter;
3. Power plant ash slurry;
4. Smelter process waters; Wastewater effluent slurry from the Hydrometallurgical Plant at the Smelter;
5. Mine leach water and meteoric contact water that have been treated in the tailings pipeline;
6. Wastewater effluent from the Reverse Osmosis treatment of sulfate-contaminated waters;
7. Neutralization of acid-mine contaminated waters;
8. Barneys Canyon mine pit dewatering and heap leach pad draindown waters;
9. Construction, maintenance and lunchroom trash;
10. Treated effluent from the sewage treatment plant; and
11. Other inflows that are approved by the Executive Secretary for this permit.

The first three waste streams listed above are included under the regulatory exclusion from RCRA as Bevill waste. Over 99% of the volume of materials placed in the impoundment are copper tailings. Items 7 and 8 are newer disposal inflows into the Tailings Impoundment. Following settlement of a natural resources damage claim, the State of Utah has approved a plan to clean up contaminated ground water in the Southwest Jordan Valley area of Salt Lake County. Over the next 40 years, extraction and treatment of ground water from contaminated zones will remove contaminants and provide municipal-quality drinking water to the public. By removing contaminated water from the underlying aquifer, the project will also improve ground water quality and prevent further migration of the contamination in the valley. In the absence of a better disposal option for contaminants removed from the treated water, the treatment concentrates will be introduced into the tailings pipeline for disposal in the Tailings Impoundment. The concentrate streams represent less than 4 percent of the total volume of material placed in the Tailings Impoundment.

These sources enter the Tailings Impoundment at the following discharge points:

- 1) West Cyclone Station
- 2) East Cyclone station
- 3) North Impoundment Single Point Discharge
- 4) North Impoundment Peripheral Discharge

Corrective Actions

The Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6) require applicants to submit a Corrective Action Plan or other response measures to be taken to remedy any violation of ground water quality standards resulting from discharges. The permit has a compliance condition that allows the Executive Secretary to

call for a Contamination Investigation and Corrective Action Plan to be submitted and made a part of this permit should future data indicate that clean-up of existing contamination at the Tailings Impoundment site is in fact needed.

Background Ground Water Quality

Assessing background ground water quality is a complicated task for the area around the Tailings Impoundment because several complicating factors impede measurement or estimation of true background. There are two previously existing facilities that may have impacted ground water quality. The abandoned Morton Salt operation and the Chevron Phosphate operation are within the footprint of the North Impoundment. These operations have likely complicated the ability to observe any impacts from tailings. In addition, given the nearly century-long history of operations, impacts from the Tailings Impoundment have probably already occurred.

In light of the aforementioned complicating factors, Ground Water Protection Levels for this permit are established using existing ground water quality on a well-by-well basis. This approach ensures that the existing ground water quality will be protected by not allowing significant degradation from existing protection levels. There are several compliance monitoring wells that are relatively close to the bedrock contact and that reflect Class II ground water quality. These wells are assigned protection levels consistent with Class II ground water. The majority of the compliance monitoring wells are placed in Class III ground water. These wells are assigned protection levels consistent with Class III ground water. Additionally, the method given in R317-6-4.6.A.3, which allows for a no net increase standard for Class III waters when the background concentration already exceeds the ground water quality standard, is used where indicated. Compliance wells completed in Class IV ground water are assigned protection levels equal to the greater of the Utah Ground Water Quality Standards, which are typically adopted from federal drinking water MCLs, or the background value plus two standard deviations, with the exception that TDS limits are not imposed for Class IV Saline ground water. Due to influences of the Great Salt Lake, TDS values in the Class IV wells range from 18,000 to over 100,000 mg/l. The basis for assigning protection levels (except TDS) to Class IV waters that are in close proximity to the Great Salt Lake is to protect wetland systems that exist in proximity to the lake and serve as habitat for shore birds and other aquatic species.

In several Class III wells, the background value for arsenic exceeds the Ground Water Quality Standard of 0.05 mg/l. In these cases a protection level equal to the background value has been set as the protection level in accordance with R317-6-4.6 (no net increase). However, because sample results from these wells routinely exceed the background value due to normal variation around the mean, probable out of compliance is defined as when concentrations exceed the background value plus two standard deviations (referred to as the compliance limit in Table 1).

Kennecott has conducted Toxic Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) analyses of tailings material to describe the toxicity of the tailings even though this material is not subject to RCRA requirements. Both TCLP and SPLP analysis did not reveal any toxicity concerns. Analytical results of these tests were below the detection limit except for barium. Barium values from the TCLP analysis ranged from 0.2 to 0.4 mg/l. The TCLP maximum limit for barium is 100 mg/l. The interstitial waters in the tailings have been characterized and do not appear problematic. To assure that the waste streams going into the Tailings Impoundment do not contain materials that differ markedly from those waste streams that have been characterized, the permit requires only materials of Bingham Pit origin and related processing wastes be disposed of in the Tailings Impoundment. There is a provision that allows Kennecott to request a variance from this standard for incidental situations that would not impact overall water quality of the impoundment.

Kennecott utilizes a discharge minimization approach with ground water monitoring to assess if any impacts occur. Discharge minimization is achieved by utilizing a natural clay liner beneath the impoundment to impede downward flow of tailings waters. The clay liner consists of the upper portion of the Bonneville Clay, which is generally 9 feet thick and is continuous throughout the northern expansion area. Measured vertical hydraulic conductivities for this segment of the Bonneville Clay range from 3×10^{-7} cm/sec to 4×10^{-8} cm/sec. The liner technology meets the requirements of R317-6-6.4.A3 and C3. Best Available Technology is defined in R317-6-1.3 as "... the application of design, equipment, work practice, operation standard or combination thereof at a facility to effect the maximum reduction of a pollutant achievable by available processes and methods taking into account energy, public health, environmental and economic impacts and other costs."

Given the liner alternatives that exist and the logistical as well as economic challenges of installation of a liner system in the north expansion portion, an area of approximately 3,300 acres, the best alternative is utilization of the Bonneville Clay as the liner to minimize seepage out of the impoundment.

The compliance monitoring well network is comprised of 28 wells in 15 locations. Most locations contain nested or paired wells: one screen interval in the upper shallow unconfined aquifer and one screen interval completed in the lower confined aquifer. The perimeter of the south and north impoundment is approximately 14 miles long. The 15 locations comprise a well frequency of about one well location per mile of embankment.

Potential Impacts to Water Quality

With the height of Tailings Impoundment reaching over 200 feet, it is likely that downward hydraulic gradients will develop and allow some movement of tailings interstitial waters through the Bonneville Clay and into the underlying aquifer systems. The average concentrations of contaminants in the interstitial waters of the tailings, when compared to the concentrations in the shallow and principal aquifers, are summarized in Table S-1 of this Statement of Basis.

While the numbers in Table S-1 are average values and some individual values may differ significantly, it is anticipated that the overall water quality of the shallow and principal aquifers will not be degraded by water from the impoundment. Interstitial waters and toe drain (recycled) waters from the impoundment will continue to be sampled semi-annually throughout the term of this permit to provide a check on quality of these waters.

One of the most important technical issues associated with the Tailings Impoundment is the long term potential for acidification of the tailings materials. The chemical reactions associated with oxidation of sulfides results in production of acid, which if not neutralized could, over time, acidify the tailings materials. Should this happen, leaching of metals and other constituents that are not mobile in neutral pH conditions may occur. Kennecott conducts static and kinetic testing of tailings materials to predict the potential for the tailings to acidify over time. Results to date indicate that the potential for the fine fraction tailings (overflow) to go acidic are low. The coarse fraction (underflow) can acidify under conditions mentioned above. To assure that signs of acidification are not showing up through the life of the impoundment, Kennecott is required to monitor the interstitial water within the tailings and to perform analysis of the copper tails inflow to the impoundment on a semi-annual basis. Surface sites on the impoundment exterior are also sampled and analyzed for acidification potential. Over time, these data may provide useful information on whether acidification of tailings is a potential risk.

The North Impoundment covers a phosphogypsum tailings pile (gypstack) in the northwestern corner of the expanded impoundment. This tailings pile was part of a phosphate fertilizer production facility that was not affiliated with Kennecott Utah Copper. Downward hydraulic gradients could move gypstack pore fluids into the shallow aquifer and toward the toe drain. Hydraulic conductivity modeling has estimated a very slow rate of travel in the mine tailings and aquifer. Two monitoring well pairs were installed to detect effects, if any, from burial of the phosphogypsum tailings. These wells have 14 years of background monitoring to establish background levels of radionuclides. Monitoring frequency has been changed to once every five years, until such time that detections of radionuclides and uranium may exceed Utah Ground Water Quality Standards.

Basis for Permit Issuance

As a basis for issuance and renewal of the ground water discharge permit as required under UAC R317-6-6.4 and to assure adequate ground water quality protection, the facility has been designed to employ discharge control technology and ground water monitoring to prevent any impairment of present and future beneficial uses of the ground water.

Ground water monitoring is the primary compliance monitoring method for the Tailings Impoundment. General monitoring of the KUC well network is performed to develop a data base and identify trends. Compliance monitoring is performed at selected wells

located outside the impoundment footprint. Most sites are situated to characterize the influence of the tailings disposal on ground water. Compliance monitoring wells are listed in Table 1 of the Permit. The compliance monitoring parameters are listed in Permit Part I, Section F.

Basis for Specific Permit Conditions

1. Corrective Action - Please see the discussion on Page 4 of this Statement of Basis for an explanation of the rationale for this condition.
2. Assessment of Acidification Potential - Ongoing analysis and testing is being required to assess the potential for the tailings material to acidify using Net Acid Generation (NAG) testing. Kennecott is required to provide an annual report that compiles the results of each year's sampling and analysis.
3. Operational Monitoring Plan - A water quality summary and analysis is required to assess long term changes to water quality over the life of this structure. The water quality of interstitial waters within the tailings, waters that are decanted from the top of the impoundment and other outflows such as seeps, and characterization of inflows will provide information that will assist in predicting potential impacts from the impoundment as well as track changes over time. This condition requires Kennecott to provide an annual report that compiles the results of each year's sampling and analysis.
4. Permit Renewal Application Items - This condition requires three items to be included in the application for permit renewal to be submitted 180 days prior to permit expiration in the year 2011. Maps of the potentiometric surface for both the shallow and principal aquifer systems will be required in order to observe temporal changes to these aquifer systems near the impoundment, and monitoring results for radionuclides and uranium in wells NET1386A&B and NET1393A&B.
5. Closure Plan - Final closure of the South Impoundment is complete. Any proposed changes to the current closure plan based on ongoing characterization of tailings mineralogy, impoundment surface oxidation, internal pore water chemistry, or other data, shall be submitted to the Executive Secretary for review and approval.

**Table S-1
Water Quality Summary of Tailings Impact to Ground Water**

Constituent	Mean Concentrations in Shallow Aquifer	Mean Concentrations in Principal Aquifer	Mean Concentrations in Tailings Pore Waters ³	Mean Concentrations in Clarification Canal ¹
pH	7.5	7.6	7.3	7.8
TDS	22373	6573	5591	9030
Sulfate ²	1900	360	1700	3569
Arsenic	0.043	0.071	0.038	0.052
Barium	0.137	0.127	0.022	0.103
Cadmium	0.002	0.001	0.003	0.006
Chromium	0.004	0.004	0.007 (51% ND)	<0.010 (ND)
Copper	0.118	0.032	0.023	0.053
Lead	0.001	0.001	89% ND	<0.005 (ND)
Selenium	0.005	0.006	0.002	0.026
Silver	0.002	0.001	94% ND	<0.001 (ND)
Zinc	0.022	0.022	0.165	0.017

All concentrations in mg/l

ND - Non Detects

1 CLC 452 : approximate mean 1991-2005. Leach water added to circuit beginning in 1998

2 Sulfate values for Shallow and Principal Aquifers were obtained from Shepherd Miller 1995

3 Values for tailings pore waters were obtained from tailings operational wells