D-1020

PDR-1
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WM-10 (2)
WM-11 (2)
WM-16 (2)

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Hydrogeology • Mineral Resources Waste Management • Geological Engineering • Mine Hydrology

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Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

WM Record File: WM-RES D1020 W+A
WM Project: 10, 11, 16
Docket No.
PDR ✓ w/o hydrographs
LPDR B, N, S w/o hydrographs
Distribution:
Coleman
Pohle w/graphs
(Return to WM, 623-SS)

RE: BWIP

Dear Jeff:

I have enclosed a brief description of the research activities that are being carried out by the Hydrology Department, University of Idaho, at the research mine visited by the NRC prior to the BWIP data review. I believe that Mr. Coleman may find this information of interest because he was one of the participants that went on the underground tour. This mine is an excellent means for studying groundwater flow in fractured media.

I have attached (mailing tube) to this letter the original large hydrographs that were prepared by Rockwell Hanford Operations for the data review. I have transferred the notes on these hydrographs to our set of 8-1/2x11 inch hydrographs obtained at the data review.

The hydrograph for borehole DB-11 is missing from both sets. The hydrograph for DB-11 was supplied upon request during the data review but the two copies (8-1/2x11) were retained by Rockwell Hanford Operations. It is my understanding that you should receive the DB-11 hydrograph in the package of information you will receive from DOE-Richland. Please forward a copy of the DB-11 hydrograph to us when received by the NRC. I am sure that Mr. Davis (Sandia National Laboratories) and Mr. Brown (Nuclear Waste Consultants) would like to receive copies of this hydrograph.

Sincerely,

Gerry Winter

Gerry W. Winter

GVW:sl

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RESEARCH ON THE BUNKER HILL MINE COMPLEX AT KELLOGG, IDAHO

Gulf Resources Incorporated has closed the Bunker Hill Complex near Kellogg, Idaho. The complex consists of the Bunker Hill underground lead-zinc mine, the mill with flotation circuits, the lead smelter, the electrolitic zinc plant and a phosphate fertilizer plant. The phosphate fertilizer plant was established at the Bunker Hill site in the late 60's in order to react acid produced by the SO_2 recovery process with phosphate ore imported from southern Idaho. The reaction produces phosphoric acid and gypsum, along with waste water that has a pH of approximately 2 and dissolved fluoride in the range of 400 mg/L. Research at the site has indicated that the fluoride produced in the phosphate fertilizer plant constitutes a tracer that can be used to track the waste waters discarded in the tailings pond. All the wastes produced at the site have been discarded in the tailings pond. These wastes consist of acid mine drainage from the mine, acid waste water from the electrolitic zinc plant, relatively neutral waste water from the smelter, neutral water from the grinding and flotation circuits that contains the tailings, and the aforementioned phosphate plant waste water. The effluent from the pond contains these wastes. This effluent is low in pH and has high concentrations of zinc, iron, fluoride, sulfate, and other ions. In order to eliminate on-going degradation of the South Fork of the Coeur d'Alene River (the receiving stream), the

Bunker Hill Company constructed a waste water treatment facility in 1974-1975. The treatment plant was completed in 1976. The treatment plant consists of lime and aeration along with settlement. The sludge from the treatment plant has been discarded in an excavated corner of the main tailings pond. This sludge may constitute an economic resource base and it is being investigated for that purpose. The pond now receives runoff and acid drainage from the Bunker Hill Mine.

The seepage from the Bunker Hill tailings pond has constituted a ground water and surface water contamination problem in the area for some time. The engineering properties, the hydrochemistry, the seepage rates, the fate of the seepage, and the mechanisms for inhibiting the loss of tailings pond water via seepage are being studied. One of the principal objectives of the research is to follow the course of the abatement of ground water and surface water contamination following dewatering of the pond. This project constitutes one of the few opportunities that researchers will ever have to determine the behavioral characteristics of a major mineral resource waste disposal facility after abandonment. The rate of decay of concentrations of fluoride and other dissolved ions in the seepage emanating from the pond have been monitored.

The second issue being addressed by the University of Idaho research program, relative to the Bunker Hill Complex, consists of the development of mechanisms to preclude the eventual discharge of acid mine drainage from the Bunker Hill Mine. The production of acid mine drainage at the Bunker Hill Mine has been investigated.

Most of the acid produced in the Bunker Hill Mine is produced above the No. 9 level. This acid is a result of the interaction of oxygen, water and pyrite rich wastes and country rock within the mine. Under operating conditions the water produced in the levels above the 9 level drains down to 9 level and discharges out of the Kellogg tunnel or bypasses 9 level and drains to a series of pumps in the lower portions of the mine where it mixes with non-acid water produced in the deeper portions of the mine. This water then is pumped from the lower levels up to 9 level. These two sources constitute the effluent that discharges from the Kellogg tunnel. When pumping ceases the water from the upper mine levels (above 9) will drain to the bottom of the mine and gradually will fill the mine with acid water. During the period of filling (probably several years) no water will be discharging from the mine. But when the mine storage is satisfied (i.e. the cone of depression has filled in) acid water will begin emanating from various points on the north slope of the mountain south of Kellogg. The acid water production rate will be somewhere in the range of 1,000 to 2,000 gpm, although the researchers believe that this discharge rate can be expected to vary with snow melt rates. Work has shown that the rate of production of acid mine drainage at the mine fluctuates as ground water recharge occurs during the period when melting snow reaches the upper levels of the mine. One of our major objectives of the ongoing research is to devise mechanisms whereby this scenario can be prevented. Ordinarily acid mine drainage can be prevented only by limiting the supply of oxygen to pyrite rich ore bodies or limiting the supply of water to the oxidation products. The latter step limits the transportability of the oxidation products. The first mechanism (elimination of oxygen) commonly is accomplished by flooding the pyrite rich mineral deposits with low oxygen water. It is not certain whether either of these techniques is feasible at the Bunker Hill site.

Work in progress at the mine consists of 1) conducting constant rate discharge tests of rocks penetrated by underground drill holes, 2) monitoring of flow and hydraulic head in selected geologic features underground and on the surface, 3) statistical analysis of data, 4) monitoring of underground flow and water chemistry in selected near-surface workings, and 5) fracture mapping and geologic mapping in near-surface underground workings of the Bunker Hill Mine.

The above projects are aimed at delineating more clearly the geologic factors that control recharge to the mine and the production of acid water in the mine. Constant rate flow tests lasting three days each have been conducted using underground drill holes. While one drill hole is allowed to flow at a constant discharge, pressure changes in near-by drill holes are recorded. Recovery is recorded for a period of time equal to the duration of the flow test. The data obtained from these tests qualitatively resemble expected theoretical curves. However, the complex nature of the fracture controlled flow system is reflected in the pressure change curves. In conjunction with this testing program, flow from selected geologic features underground is being monitored. Additionally, shut-in pressure in underground drill holes is being measured and water elevation in surface piezometers is being recorded.

Monitoring of underground flow and water chemistry in the Homestake workings of the Bunker Hill Mine has been initiated. The Homestake workings constitute the workings closest to the surface where acid production occurs. Recharge to, discharge from, and water quality degradation within the Homestake workings are being documented. Water flow and chemistry at five sites on the No. 5 level are still being monitored. These data are expected to allow the data from the Homestake workings to be related to the existing flow and water chemistry data from the rest of the mine. Additionally, mapping is being conducted to determine the maximum volume of ponded water within the Homestake workings. We are investigating the hypothesis that ponded water may play a substantial role in the production of acid mine drainage.

During the last year, two portions of the ongoing project have been completed. The work on the tritium age dating of underground water is complete. Pre-bomb water is found at depth in the mine while younger post-bomb water is found both shallow and at depth in the mine. The age of the water in the mine did not correlate directly with any type of geologic structure that we have identified to date. In addition, our initial mathematical modeling study has been completed.

Three years of water flow and water chemistry data at 22 sites underground have been collected. This long term effort has produced a unique data base. The mine was inactive during the entire period of data collection. As a result the data represent the actions of the natural flow system with no perturbations due to importation or distribution of water for drilling, sand backfill operations or other mining activities. Many statistical techniques require at least three years of data in order to apply the techniques.

Statistical analyses of 1) fracture and fracture flow data, and 2) three years of underground flow and water quality data is ongoing.

Acid production and water quality degradation will be analyzed as a function of specific structural geologic features. This work compares acid production in bedding planes, joints, faults, rock bolt holes and drill holes to one another. This work also focuses on determining how far away from the drift walls acid production occurs. Existing exploration drill holes, rock bolt holes and selected geologic features are being used. A limited amount of drilling is anticipated if existing holes cannot provide enough variation in depth from the drift walls.

Surfactants will be tested for killing bacteria in selected areas of the Homestake workings. This work applies methodologies developed for use in coal mines to a hard rock mine.