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CIMARRON MILL, CARRIZOZO, NEW MEXICO: A TYPICAL SUPERFUND SITE?

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Abstract—The Cimarron Mill in Carrizozo, New Mexico, was operated by Southwest Minerals Company under the name of Cimarron Mining Company (CMC) as a cyanide mill for gold recovery from 1979 until 1982. In 1980 the New Mexico Environmental Improvement Division (NMEID) received a report of improper use and dumping of cyanide at the site. A certified notice of violations was sent to CMC in 1982 by NMEID for discharging into a non-permitted discharge pit. CMC filed for bankruptcy in 1983 so no action on the violations was taken by the state. A Site Inspection Follow-Up Report was done by NMEID in 1984 and in 1988 the mill site was listed as a Superfund site by the Environmental Protection Agency (EPA). A feasibility study to determine the method of remediation was completed by EPA contractors in June 1990 and a remediation method was chosen in September 1990. Clean-up will be done by an EPA-supervised contractor and is expected to begin in spring of 1991 and to be completed in 1992.

HISTORY

The Cimarron Mill site, located approximately 0.53 km east of the intersection of U.S. Highways 54 and 380 in Carrizozo, New Mexico (Fig. 1), is an inactive milling facility built in the late 1960s and originally operated for the purpose of concentrating iron ore, with the last recorded shipment in the mid-1970s. The mill changed ownership six times between 1977 and 1979 and was finally purchased and operated by Southwest Minerals Company (SMC) under the name of Cimarron Mining Company (CMC). This company became convinced that the iron ore the mill had previously been processing contained large amounts of gold. They were so convinced that they re-purchased the iron ore tailings which had been given away by the original mill owner to townspeople for driveway fill (C. Dotson, personal comm., 1988). In order to recover this gold, the iron-ore concentration process was changed to a cyanide process. The cyanide process was evidently not recovering sufficient gold, so it was modified further to use a combination of a cyanide salt and a metal stripper of the type used to recover gold from electronic parts.

In February 1980, the New Mexico Environmental Improvement Division (NMEID) received a report of improper use and dumping of cyanide at the site (Swickard, 1980). Until this point, the NMEID had been unaware that the mill was operating without the permits necessary for conducting cyanide milling and processing. The NMEID sent a certified notice of violations to SMC on June 22, 1982 (letter from Russell Rhodes, Director, NMEID to Robert Watson, Production Manager, Cimarron Mining Company). No action was taken by the state because operations at the site ceased in July 1982 and the company filed for bankruptcy in July 1983 (K. H. Malone and Ray Roblin, unpublished final Report for Expanded Site Inspection, Cimarron Mining Company, Carrizozo, New Mexico, for USEPA, 1988, p. 2-1).

NMEID field inspections in May and June 1984 (Anonymous, unpubl. report for NMEID, 1984), revealed cyanide in shallow ground water, soil and mill tailings. Mercury, selenium, arsenic, lead and copper were also reported in potentially hazardous concentrations in ground water, soil and tailings. Site facilities included two concrete-lined cyanide solution tanks, an unlined discharge pit, an unlined tailings impoundment, and several tailings piles. Stored in various places on the site were ten 55-gallon drums of cyanide salts, 26 containers of metal stripper compounds and approximately 100 55-gallon unlabeled drums believed to be "concentrates." According to a local source (R. Forsythe, personal comm., 1988), these drums were shipped to the Asarco Smelter in El Paso for sale as gold concentrates. Asarco, after assaying the "concentrates," refused to buy them and the drums of "concentrates" were shipped back to Cimarron at the owners' expense.

In autumn 1984, the NMEID requested that EPA authorize a Resource Conservation and Recovery Act (RCRA) 3012 Site Inspection Follow-Up (SIF) action. Based on the results of the May and June Site Inspection Report (Anonymous, unpubl. report for NMEID, 1984) the

NMEID performed a trial ranking of the site to determine if it scored high enough (at least 28.5 points) to be nominated for the Superfund National Priorities List (NPL). The results indicated that the site was within three to five points of the cutoff score of 28.5. NMEID proposed additional work to obtain the information necessary to document reliably a higher score.

The Work Plan for the SIF contained two parts. First, the NMEID proposed to document an air release at the site and second, to quantify the waste volume available to the ground water and air routes. NMEID initially proposed subsurface borings to show the distribution of contaminants with soil depth. EPA determined that this procedure would not be appropriate. Instead, volumes of waste at the land surface should be quantified (Anonymous, unpubl. Site Inspection Follow-Up Report for NMEID, 1984). The air-quality study was never implemented and I can only assume that it was finally deemed inappropriate. The actual SIF therefore involved a detailed survey of the volumes of mill tailings, ore piles, and drums of materials at the site. Following the SIF, EPA

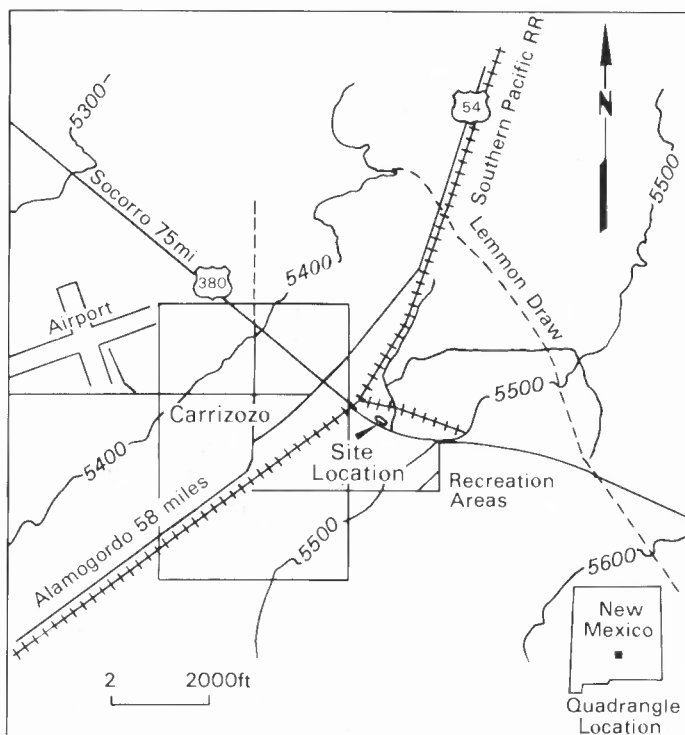


FIGURE 1. Superfund site, Cimarron Mining Company millsite, Carrizozo, Lincoln County, New Mexico.

and NMEID prepared a final-ranking package for the site. A final score of 38.93 was obtained which exceeded the 28.5 minimum and the site was nominated for the NPL (Federal Register, 53 FR 23988, June 24, 1988). Thus the Cimarron Mill became an official Superfund Site.

Ecology and Environment, Inc. of Dallas, Texas, was hired by EPA to conduct an Expanded Site Inspection (ESI) which included surface and subsurface sampling, installation of monitoring wells and sampling ground water in the wells, sampling municipal drinking water wells and irrigation wells near the site, and identifying adjacent land uses. The final report (K. H. Malone and Ray Roblin, 1988, unpubl. Final Report for Expanded Site Inspection, Cimarron Mining Company, Carrizozo, NM for USEPA) listed the following conclusions:

1. Both the surface and subsurface soils are contaminated with cyanide (0.88 to 21 ppm), arsenic (15 ppm), chromium (11 to 19.6 ppm), mercury (0.11 to 0.18 ppm) and cobalt (6.8 to 209 ppm).
2. The first water bearing unit is contaminated with cyanide (21.3 to 1970 ppb), lead (81 to 150 ppb), manganese (796 to 10,400 ppb), chromium (0.55 to 384 ppb), cobalt (125 to 246 ppb) and mercury (0.25 to .62 ppb).
3. The process bathing tanks contain hazardous materials, confirming that cyanide and metal stripping agents were used on site. These materials were disposed into an unlined, nonpermitted discharge pit and solid wastes were placed directly on the ground at the tailings waste pile area. The solid and fluid discharges have contaminated groundwater, surface and subsurface soils at the site.
4. Groundwater contamination in the first water bearing unit appears fairly widespread in relation to the site. Water flow direction in the unit appears to be to the northwest, but seasonal variations in water levels and massive pumping of the lower aquifer by irrigation wells at the recreation area may cause a reversal of flow direction.
5. The tailings waste piles are sources of subsurface contamination but their primary release mechanism would be windblown erosion and dust. Although air sampling was not conducted, contaminant release through windblown erosion of the piles is considered likely under the arid conditions of south-central New Mexico.

This site is on alluvial fans fed in part by debris from local mining districts (see, for example, Griswold, 1959). Elevated levels of heavy metals are not unusual in this type of situation. The values of heavy metals, as listed in this report, in surface and subsurface soils are what would be expected. Furthermore, the ore was brought to the site for the very reason that it contained elevated levels of heavy metals. Water samples taken from monitoring wells were acidified but not filtered. The values obtained therefore reflect the heavy metals in any sediment brought up with the water, or sediment which might have been carried into the well from the surface by the drill bit. Neither would be soluble in the ground water under existing conditions nor would move through the ground water. Cyanide determinations were for "total" cyanide and did not include any consideration of the form in which the cyanide might be present. Iron cyanide complexes, the form of cyanide most likely to be present, are very stable and therefore unlikely to be hazardous. EPA's definition of hazardous substances is based on total amounts present, and does not take into consideration solubility, biological availability or site specific conditions and thus whether it is actually hazardous.

On September 29, 1988, EPA held a briefing about the investigation in Carrizozo. Alarmed townspeople had contacted the New Mexico Bureau of Mines and Mineral Resources (NMBM&MR) and two representatives from the NMBM&MR attended the meeting. A "fact" sheet was handed out at this meeting which contained the following information:

During 1979-1982, Cimarron Mining Corp., also known as Southwest Minerals Corp., operated a mill that recovered metal from ore transported to the site. The process used a 50/50 solution of cyanide salt and metal stripper. The mill was previously operated by Sierra Blanca Mining and Milling for the extraction of gold with cyanide. Both processes generated a liquid containing cyanide and heavy metals. Analysis conducted by the state detected cyanide and heavy metals in groundwater, soil, sediment, and tailings on the site. Cyanide was detected at a concentration of 116 milligrams/kilograms [sic] in a water sample taken from one holding pond in April 1982. In May 1984, a tailing pile sample contained 46.4 mg/kg of cyanide. The levels are potentially toxic to human health.

This briefing gave the public the first official information about the site. The previously mentioned reports had been circulated only at NMEID and EPA. Yet the EPA officials at this meeting could give no specific information about the site to the interested parties. One individual (Cherry, 1988) stated at the meeting that the way the amount of possible hazardous waste was presented by EPA was terrorizing as well as incorrect. This individual, a former manager of the mill, stated that at no time was a 50/50 solution of cyanide salt and metal stripper used; only very dilute solutions of each were used. EPA later corrected their statement to reflect these dilute solution concentrations in subsequent Superfund Fact Sheets. NMBM&MR personnel pointed out that cyanide breaks down in a very short time (months to several years) to non-hazardous substances. Because operations at the site ceased in 1982, sufficient time had passed for all the cyanide to break down.

EPA hired a contractor (Camp Dresser & McKee Inc.) to perform the Remedial Investigation (RI) and Feasibility Study (FS). An RI assesses the type of contaminants present, identifies the degree of contamination, and characterizes potential risks to the community. An FS examines the feasibility of various alternative remedies. An "open house" was held in March 1989 in Carrizozo by EPA and the contractor to inform interested parties about the work to be done at the site. NMBM&MR representatives at the meeting attempted to convince EPA and their contractor that on the basis of the study by Ecology and Environment, Inc., and the geology of the site, the cyanide contamination would be confined to the shallow ground water. Therefore it would not be necessary to drill more monitoring wells. However, more monitoring wells were drilled on and off site, bringing the total to 17 wells. More surface soil samples and more unfiltered acidified groundwater samples were taken. These were shipped for analyses to a lab on the East Coast.

MITIGATION

The representative of the court handling the CMC bankruptcy was approached by individuals who wished to purchase equipment and materials from the site. These individuals were referred to EPA because nothing could be removed from the site without their permission. The New Mexico State Highway Department was building a new highway west of Carrizozo and was interested in buying the unprocessed ore from the site for highway fill. EPA refused to consider this offer until after the RI and FS had been completed which was estimated to be late 1990 (letter from William Rowe, Enforcement Section, EPA, to Ralph Forsythe, March 22, 1989). One individual (letter from William Rowe to Barry Allen, April 5, 1989) inquired about buying the property, cleaning it up, and operating the mill at the site. He was told that if he purchased the property he would become a Potentially Responsible Party under CERCLA and would be responsible for some or all the costs associated with the clean-up of the site, which would have to be done under EPA's oversight. Another individual (letter from William Rowe to Richard A. Benner, Jr., April 5, 1989) inquired about buying the equipment and moving it to another site for use in a cyanide mill. He was told that any equipment which had cyanide residuals on it (ball mill, vats, piping, tanks, etc.) would have to be decontaminated before leaving the site. A decontamination plan would have to be submitted to EPA for approval and would have to include: dismantling the equipment, hauling equipment by crane to a cleaning area (a child's wading pool to collect rinse solutions), steam cleaning equipment, testing to determine disposal options for rinse solutions, and chemicals to be used in steam cleaning. The cleaning would have to be done under EPA supervision and EPA personnel would have to be compensated for their time plus travel and per diem. All this for equipment which would then be used in a similar cyanide process at a different site. The drums of cyanide salts stored at the site were removed without EPA participation by a local townsperson at a cost of \$100 per barrel and donated to a cyanide mining operation in the state (Harrold, 1989).

In March 1990, EPA held a workshop in Carrizozo which NMBM&MR representatives attended, to present the preliminary results of the field sampling done the previous October. EPA representatives announced that on-site monitoring wells in the shallow ground water were heavily

contaminated (up to 4330 ppb), although off-site wells were not impacted (Harrold, 1990). Soil and surface water runoff and air were not contaminated at levels above health-based criteria. Questioning brought out that the well that was reported to contain 4330 ppb cyanide had been analyzed on previous occasions and had yielded the following levels of cyanide: 360, 1970, 3000, and 101 ppb. Yet EPA was using only the 4330 ppb value as an example of the heavily contaminated well at the site. EPA estimated that at that time approximately \$531,000 had been spent at the site. The final conclusion was that one shallow well at the site had been contaminated with cyanide. The amount of ground water impacted was thought to be about 3 million gallons.

The FS was completed in June 1990 and in July EPA held a public meeting to solicit comments on the various proposed remedies. In September EPA announced the selected remedy. This remedy consists of using extraction wells to pump contaminated ground water to the surface and discharge it to the public sewage system where it will be treated by the local sewage treatment plant. The remediation will take approximately 13 months and cost approximately \$95,000. Work should begin on the site in early 1991.

EPA had done such a good job of convincing the townspeople of the dangers at the site that when first informed of EPA's solution, they were

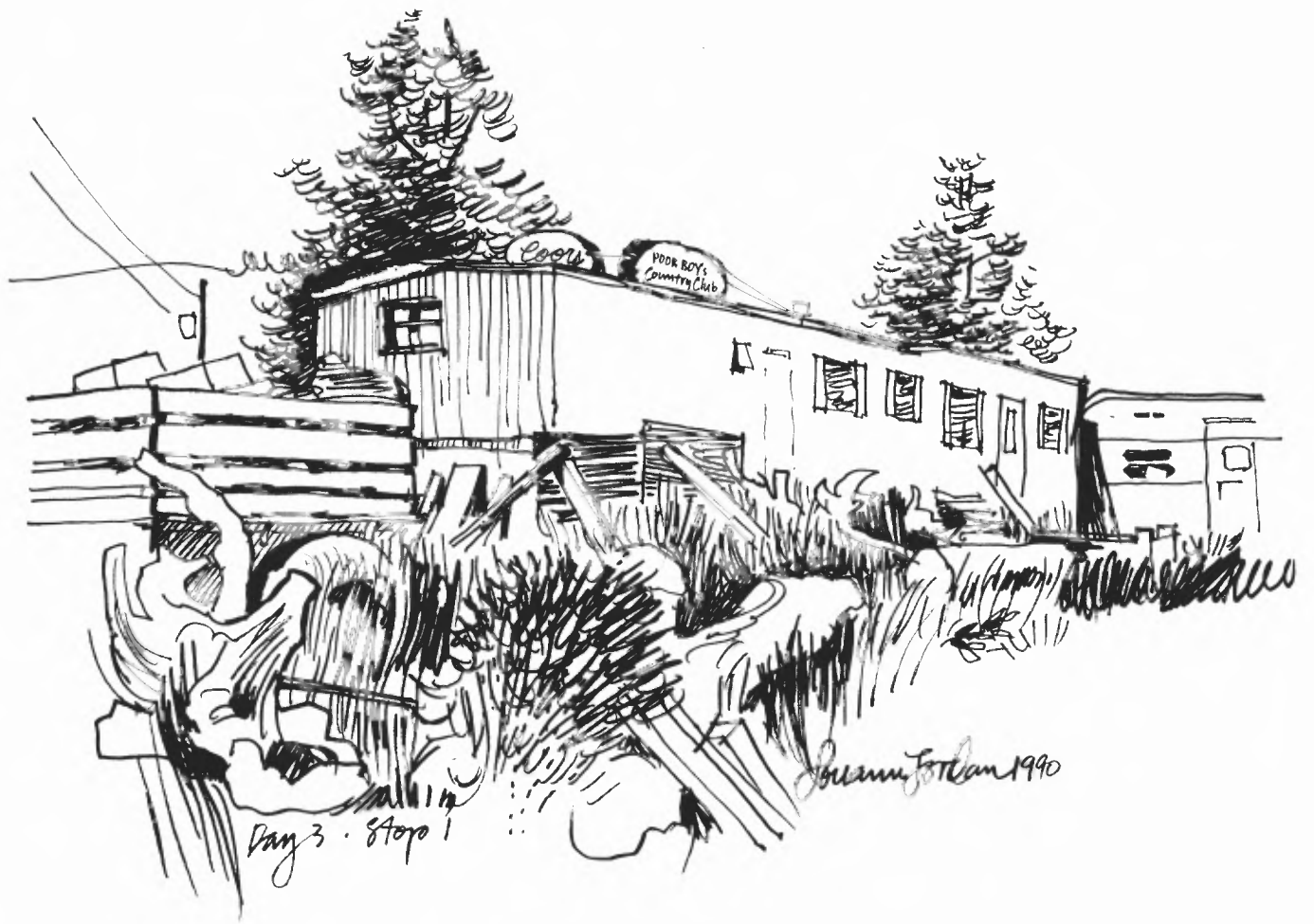
alarmed that EPA would put that "hazardous" material in their sewer system. NMEID and NMBM&MR representatives agreed with EPA that any cyanide would be destroyed by aeration and bacterial action in the sewage treatment plant and helped to convince the townspeople that this was a safe manner of destroying cyanide.

ACKNOWLEDGMENTS

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Poor Boy's Country Club near Black Lake. The Club was closed when the 1990 NMGS Field Conference (Day 3, Stop 1) arrived at 8:30 a.m. so facilities were not used. Suitable refreshments were consumed later in the day. Illustration by Louann Jordan of Santa Fe, 1990.