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ZONIA JOINT VENTURE

Antioch Resources, Inc.
4940 M Corp Plaza,
333 Clay Street
Houston, Texas 77002-4103

Queenstake Resources U.S.A., Inc.
365 O'Brien Way,
Sparks, Nevada 89431
Telephone: (702) 356-3888

April 29, 1986

Mr. Greg V. Arthur
Water Management Division
United States Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, Ca 94105

Dear Mr. Arthur:

Re: Zonia Mine, Yavapai County, Arizona; - Your reference 308-FY86-011

This letter is in response to the letter from Mr. Frank M. Covington of your agency to Mr. Gordon C. Gutrath, President of Queenstake Resources Ltd. dated January 31, 1986 which was forwarded by Mr. Gutrath along with a copy of his reply to your letter.

By way of summarizing the information contained in Appendix A (attached), we would note that no point source discharge occurs from the Zonia Mine to waters of the United States or to publicly owned treatment works. Accordingly, we have been advised that the provisions of the federal Clean Water Act would not appear to be applicable to the Zonia Mine.

We wish to advise that the property has been in compliance with state groundwater standards through a groundwater control program undertaken by McAlester and apparently approved by representatives of the Arizona Department of Health Services during 1982. Also we have taken steps to comply with applicable provisions of the groundwater protection regulations promulgated by the Arizona Department of Health Services (ADHS), R9-20-201 through R9-20-226 (July 19, 1984). Pursuant to these regulatory requirements, a notice of disposal is being prepared for filing with ADHS.

Please address all further inquiries regarding this matter to Antioch Resources, Inc., 4940 M Corp Plaza, 333 Clay Street, Houston, Texas 77002-4103 and cc: to Queenstake Resources U.S.A., Inc. at 365 O'Brien Way, Sparks, Nevada 89431 and to Enstar Petroleum, Inc., 3900 M Corp Plaza, Houston, Texas, 77002-4103.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Yours truly,

ZONIA JOINT VENTURE



R. C. Atkinson
ANTIOCH RESOURCES, INC.



D. D. Sharp
QUEENSTAKE RESOURCES U.S.A., INC.

dds/US3

cc: Enstar Petroleum, Inc. (E. J. Vandermark)
Arizona Department of Health - Mr. Lyndon R. Hammon & Ms. Selly Mapes
Water Permits Unit; Office of Waste and Water Quality Management

APPENDIX A

1. GENERAL INFORMATION

a) Owner of the Zonia Mine Property:

Antioch Resources Inc.,
4940 M Corp Plaza
333 Clay Street
Houston, Texas 77002-4103

Joint Venture:

After acquiring the property, Antioch entered into an exploration joint venture with Queenstake Resources U.S.A., Inc. (365 O'Brien Way, Sparks, Nevada 89431) on April 30, 1984 whereby Queenstake Resources U.S.A., Inc. can earn a 50% interest in the joint venture. Queenstake subsequently delivered notice of its intention to surrender its interest in the joint venture to Antioch which transfer shall be effective on July 17, 1986 and after which Antioch shall be the owner-operator of the Zonia Mine Property.

b) Operator of the Mine Property:

Queenstake Resources U.S.A., Inc.
365 O'Brien Way,
Sparks, Nevada 89431

c) Property Location:

Township 11N R4W Sec 1, 11, 12, 13, 14, 15, 23
Township 11N R3W Sec 6, 7

d) Storm Events:

10 year 24 hr. storm event: 3.2" (N.W.S. Phoenix)
100 year 24 hr. storm event: 4.5"

e) Current Mining Operations:

There are no current mining operations at the Zonia Mine. The Zonia Mine was operated by McAlester Fuel Company as an open pit, heap-leaching cement copper mine and plant from 1966 to 1975, when the mining operations were terminated. The property has been on a standby, watchman status since that time. Antioch Resources, Inc. purchased the property in 1983 and a joint venture was formed between Queenstake Resources U.S.A., Inc. and Antioch to evaluate the vein-hosted gold mineralization peripheral to the oxide copper deposits exploited in the past. The exploration program consisted of surface sampling and mapping with underground rehabilitation of one shallow shaft which was also sampled. These exploration activities have no effect on the groundwater or surface waters of the mine property and have resulted in no discharge of waters from the mine workings investigated.

f) Current Caretaking Operations:

Caretaking operations at the Zonia Mine consist of a two watchman crew whose duties include the periodic pumping of meteoric water accumulations from the former leaching basins to a holding pond for evaporation, as well as general maintenance of the roads, facilities, pipelines, pumps, and equipment at the mine site.

The objective of the reservoir and pumping system at the Zonia Mine is to prevent discharge of meteoric solutions which percolate through the old leach basins. The system utilizes the pumping and plumbing system used during operations of the mine during production, with some modifications. Water accumulations from leach basins LB-1, LB-7 and LB-9 are collected in perforated pipe underdrain systems beneath the leach basins and are transported by gravity through pipelines to the collection reservoir at the former plant site, where it is then pumped to the discard solution reservoir for disposal by evaporation. Leach basins LB-5 and LB-6 are in-situ leach basins created in 1972, which have their fluid levels maintained by wells situated in the lower portions of the basins. As determined by McAlester Fuel Company and the Water Development Corporation of Tucson, Arizona, the maintenance of established fluid levels in leach basins LB-5 and LB-6, will result in no seepage of meteoric water accumulations from the leach basins. The basins are consequently pumped on an irregular basis, dependant upon precipitation, with the fluids being transferred to the discard solution reservoir.

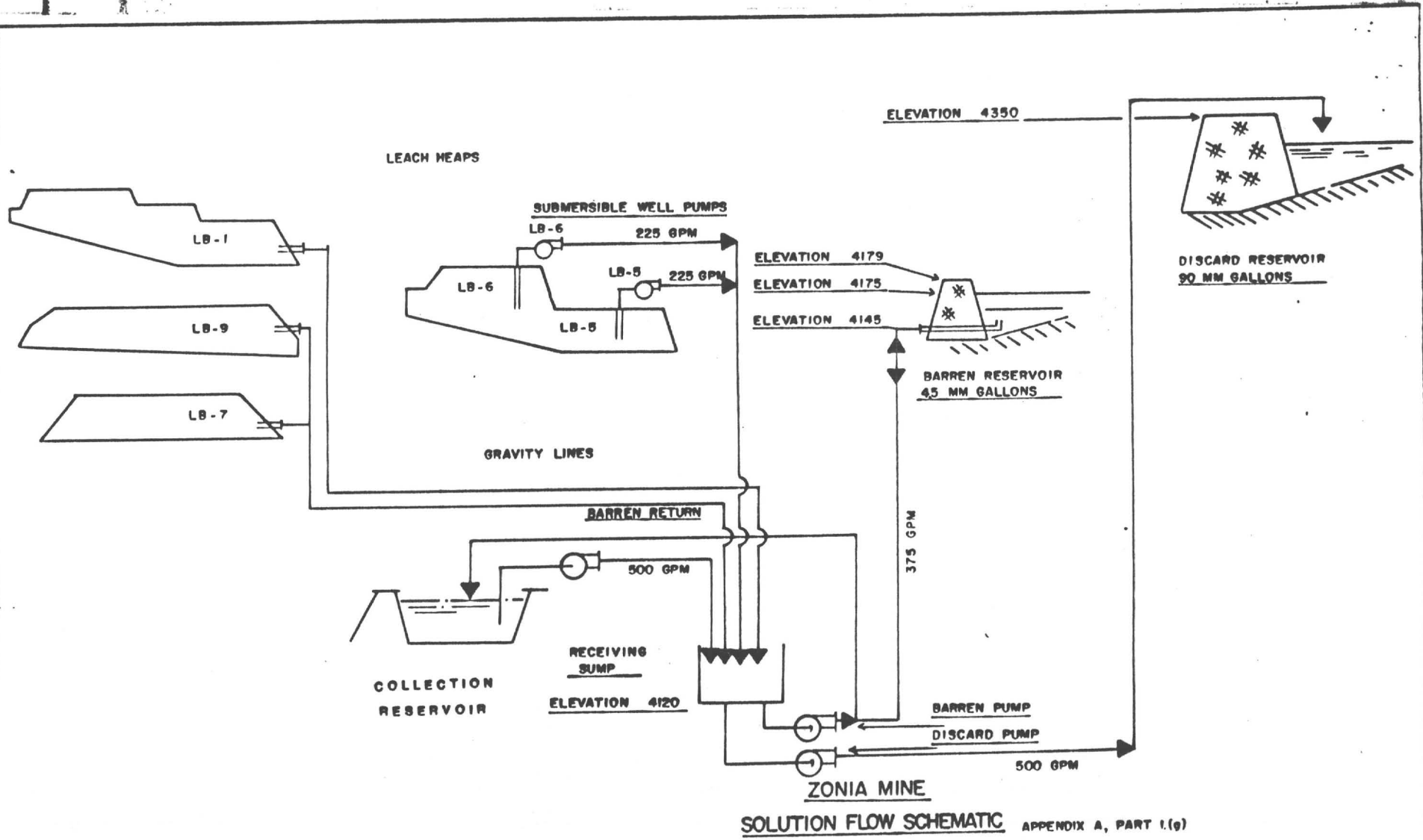
2. WASTEWATER MANAGEMENT

The wastewater management system at the Zonia Mine, as outlined on the attached schematic drawing, consists of a circuit of drainage pipelines and recovery wells connected to a storage and pumping facility which transfers the collected solution to a large holding reservoir for evaporation. All rain and snowmelt which reports to the leach basins eventually percolates into the water drain collection system or well sites and is directed to the discard solution reservoir. During periods of high volume runoff, the excess solution (greater than 500 GPM), which cannot be pumped directly from the plant site to the discard solution reservoir, is stored temporarily in the barren solution reservoir. When the overall flowrate subsides, the barren solution reservoir is then drained and pumped to the discard solution reservoir.

The system provides for total water containment and no discharge to any surface stream. Inflows are infrequent surface runoffs and there is no mine drainage problem. There is diversion of runoff away from disturbed areas. There is a net loss of precipitation through evaporation (no water balance problem).

With the current pumping capacity, the total pumping rate from the plant site is 875 GPM with 500 GPM being pumped to the discard solution reservoir and the remainder to the barren solution reservoir. This rate can be maintained until the barren reservoir is filled. At the above rate, with continuous pumping, the barren reservoir will impound at least 200 hours of pumping. After this time, only the discard reservoir can be operated, limiting pumping capacity to 500 GPM.

Each of the impoundments, leach basins, reservoirs, and pumping systems is described in more detail below, in response to part 2. a) of Appendix A, No. 308-86FY-011, page 2.



SOLUTION FLOW SCHEMATIC APPENDIX A, PART 1.(g)

April, 1986

a) IMPOUNDMENTS:

Discard Solution Reservoir

The discard solution reservoir is a large (20.91 acres) storage basin located approximately 6,000 feet southwest and 250 feet above the plant site, near the upper reaches of French Gulch. The impoundment has a reported capacity of 90,254,000 gallons with five feet of freeboard. At present it is estimated to be impounding less than 25 percent of permissible volume. No drawings or notes on the construction of the dam have been located in the files remaining at the mine office, but the crest of the dam is over 150 feet wide and the downstream slope is estimated to have a slope of 2 or 2.5 to 1.

McAlester records indicate the dam was constructed in 1969, using high clay material from the open pit, compacted with a sheep's foot. When the dam was finished to the proper dimensions the water face was covered with rock rubble. The watershed of the pond requires at least five feet of freeboard to allow for a 100 year storm event. Since construction, the dam has not leaked or seeped, and the downstream drainage below the dam and above French Gulch shows no sign of leakage or increased spring activity.

The water level of the discard solution reservoir fluctuates with seasonal runoff and pumping input. The evaporation rate for the reservoir has been estimated at 5 to 7 GPM/acre, or about 105 GPM when full. According to data published by the Arizona State University Laboratory of Climatology, average annual lake evaporation in this region is approximately 75 inches. With annual precipitation averaging 20 inches at the mine site over the past decade, the net annual evaporation rate would be about 55 inches. The basin receives water from all of the leach basins and plant site runoff via pipelines of 6 and 8 inch heavy wall plastic pipe. This line is fed by the discard solution pump at the plant site which is a 4 inch by 3 inch Gould model 3196 pump with a 75 HP motor directly connected. The pump has a maximum capacity of 500 GPM against a TDH of 375 feet.

As this pump is critical to the runoff management system at the Zonia Mine, a spare pump and motor are reserved in the case of pump or motor failure. The spare pump is also a 4 inch by 3 inch Gould model 3196 with a 100 HP motor directly connected. This pump can deliver up to 650 GPM to the discard solution reservoir at a TDH of 387 feet.

The magnitude of runoff in the watershed (122.6 acres) would be 20,005,463 gallons for a 10 year storm event and 28,132,683 gallons in a 100 year storm event.

There are no mine facilities in the watershed of the impoundment.

Barren Solution Reservoir

The barren solution reservoir is utilized as a temporary holding pond for water received by pipeline from the leach basins, prior to pumping the solutions to the discard reservoir. The reservoir is located about 500 feet southwest of the plant site and was formed by constructing a large dam across the mouth of a small gulch. According to drawings prepared by Coe and Van Loo, Consulting Engineers, the dam is 20 feet thick at the crest and 214 feet at the thickest portion of the base. The down stream slope is 2:1 and the upstream slope is 2.5:1, the base was grubbed prior to placement of the impoundment material and the dam is keyed to the natural surface with a 28 foot wide by 10 feet deep slot. A toe drain was installed which extends 70 feet into the impoundment from the top. The exposed portion of the drain has a perforated pipe installed to facilitate capture and removal of any seepage. A 4 inch heavy wall fiber reinforced plastic pipe extends through the dam which has seven anti-seepage rings or seep dams to prevent piping of the solution along the pipeline. This pipeline connects with the pumping system at the plant site and the adjacent collection reservoir.

The barren reservoir pump is a 3 inch by 2 inch Gould model 3196 pump with a 60 HP motor, connected direct. This pump delivers solution to the barren solution reservoir for immediate storage when necessary. The maximum capacity of this pump is 375 GPM while drawing approximately 30 to 35 horse power.

The total capacity of the basin is 4.5 million gallons with 9 feet of freeboard. The volume of water present in the barren solution pond fluctuates with precipitation and pumping operations. The maximum volume held in the past two years is 4.5 million gallons. The average level in the basin is estimated at about one-fifth of capacity or 900,000 gallons.

The watershed of the barren solution pond includes only the small basin in which the pond is situated, an area of 2.8 acres. A 10 year, 24 hour storm event, would generate 244,363 gallons of runoff water and during a 100 year storm event 343,636 gallons of runoff would report directly to the reservoir from the surrounding slopes.

The mine facilities in the watershed of the barren solution reservoir are roads and a small section of the northern mine dumps (see Exhibit A).

Collection Reservoir

This reservoir is located directly adjacent to the pumping facility at the plant site. It is relatively small and has an estimated capacity of less than two million gallons. It is bounded on the north and west by a levee which borders French Gulch, and on the south and east by the plant site and roads leading to the barren solution pond and leach basin LB-1 (see Exhibit B). The reservoir consists of a shallow, clay-lined basin cut in the alluvium. Runoff in the plant area reports to the reservoir while some runoff from the hill area east of the plant site is directed into French Gulch in drainage alongside the access roads. The watershed area for the plant site is estimated at 2.3 acres.

The collection reservoir is used as a temporary solution holding pond for the final stage of pumping to the discard reservoir and receives waters from all of the mine facilities. Flow rates and volumes of water held in the collection reservoir fluctuate greatly depending upon the rate of precipitation and runoff from the leach basins. An estimate of the average water volume in the pond since the initiation of pumping would be on the order of 1 to 1.25 million gallons, while in maximum runoff periods the full capacity may be utilized.

A ten year storm event on the estimated 100,000 square foot area of watershed for the plant site would create 199,480 gallons of runoff, while a 100 year 24 hour storm event would yield 280,520 gallons of runoff.

The former plant site which consists of concrete storage tanks, repair shop, pump station, and concrete plant foundations are within the watershed of this reservoir.

Evaporation Pond (abandoned)

This impoundment was utilized as a barren solution evaporation pond during operations by McAlester Fuels and has been unactive since the cessation of operations in 1975. The pipeline servicing this basin was sold for scrap by McAlester in 1979 and no solutions have been pumped to it since before that date. A small seasonal pond forms at times in this small, closed basin, but the pond evaporates completely in dry years.

No plans showing the construction of this pond could be located in the data left at the mine, but it appears to be a well constructed earthen dam with a very small 9.7 acre watershed. Total capacity of the basin is estimated at about 2.5 million gallons. The only water sources for this basin are seasonal rain and snowmelt. A ten year storm event would generate approximately 843,400 gallons of runoff into the basin and a 100 year storm event would generate 1,186,364 gallons. There are no mine facilities in the watershed of this impoundment.

Leach Basins

The leach heaps at the Zonia Mine property also act as solution impoundments, and will be discussed as such in this application. The underdrain collection systems within the leach basins will also be outlined in section 2. b) below.

The leach basins at the Zonia Mine were constructed by McAlester Fuel Company between 1966 and 1972, and consist of three large heap leach piles and two smaller in-situ leach basins. Blueprints of LB-1 show that the basin was built by smoothing the topography of a 1,500 foot long valley; and covering the flanks and floor of the basin with two layers of impervious material (asphalt) separated by compacted fill overlying the natural ground surface. The basin is drained by an 8 inch perforated conveyance line set in a 36 inch wide, two foot deep trench filled with 1/2 inch to 3/4 inch gravel. Six foot high division dams separate the basin into several sections which were benched as each additional lift of ore was added.

The rain and snowmelt which percolates through the leach basins reports to the pipeline that exits the face of the pile and reports to the collection reservoir. Not all rainfall which falls in the basins reports to the discharge line at the same time due to the variance in permeability and porosity of each particular leach basin. Each of the leach basins will be described in more detail below.

Leach Basin 1:

Leach Basin 1 is the largest and original heap leach area at the Zonia Mine property. The basin is approximately 1,500 feet long and averages about 350 feet wide, containing 3.6 million tons of broken ore and is divided into six heaps covering a total acreage of 18.5 acres. The basin is drained by an 8 inch fiber reinforced plastic pipeline which leads directly to the weir at the pumping facility. Rainfall and snowmelt are the only water sources for basin LB-1 at present.

Without additional data as to porosity and permeability, the total capacity of the leach pads cannot be estimated, the average and maximum waters held in the leach basins also cannot be calculated without further extensive hydrologic testing.

The estimated precipitation volume within the watershed (33.3 acres) of leach basin LB-1 from a 10 year storm event would total 2,892,470 gallons and from a 100 year storm event, 4,069,070 gallons of water. Some of the rain and snow which fall on the leach pads would pond on the upper surfaces of the leach piles and would seep into the pile, resulting in flow attenuation while the remainder would run off in a large storm event.

Leach Basin 7:

Leach basin LB-7 is a small heap situated between basins LB-1 and LB-9 containing 347,045 tons. The surface area of the heap is 3.74 acres, with a watershed of 13.89 acres. No plans or construction drawings could be located for heap LB-7 at the mine, so it is unclear how it was built. An eight inch solution line leading from LB-7 joins with the discharge line from LB-9 and extends along French Gulch to the plant site. Again, the only waters emanating from LB-7 are meteoric accumulations.

The estimated runoff from leach basin LB-7 in a ten year storm event would be 1,206,950 gallons and 1,697,280 gallons for a 100 year storm event. Only the leach pad, roads and pipelines are in the watershed of LB-7.

Leach Basin 9:

LB-9 is the final heap built by conventional methods at the Zonia Mine and covers an area of 26.9 acres. The construction of the heap is thought to be similar to LB-1 and LB-7, as it lies within a small drainage, although no plans showing the construction of the basin could be located.

The basin is drained by an eight inch diameter PVC pipeline which connects with the line draining LB-7 and runs down French Gulch alongside the creek. Where the line crosses the path of French Gulch, the line is buried approximately four to six feet underneath the dry streambed to prevent washouts during periods of high runoff. The pipeline is reduced to a four inch diameter PVC line at this point, extending to the plant site weir.

The only water source for leach basin LB-9 is seasonal precipitation as with the other leach basins. The capacity and volumes of waters held in LB-9 cannot be estimated based on available data. The volume of runoff resulting from a 10 year and 100 year 24 hour storm event from the watershed (61.29 acres) of LB-9 would be 5,325,700 gallons and 7,489,290 gallons respectively. Only the access roads and pipeline from the pumping facility to the discard solution reservoir are within the watershed of LB-9.

Leach Basin 5, Leach Basin 6:

The most recently worked leaching areas at the Zonia Mine property are Leach Basin LB-5 and LB-6, located to the northeast of the Zonia open pit. The ore bearing rocks at these locations were fractured in place in 1972, and the area was leached in-situ. Leach basin LB-5 covers 10.68 acres and LB-6 covers 4.77 acres. The blasting was designed to fracture the rock to a depth of 4,000 feet in elevation, approximately 10 to 20 feet above the water table prevalent at that time.

After blasting, LB-5 was bulldozed into a series of stepped terraces, the highest at 4,150 feet in elevation and the lowest at 4,050 feet. LB-6 was benched at an elevation of 4,165 feet. After levelling of the leach pad, a series of acid resistant 12 inch diameter wells were constructed for recovery of the copper bearing solution, with a system of sprinklers installed to spray dilute sulfuric acid on the surfaces of the leach basins. Later, a series of injection wells were drilled to pump leach solutions into the broken ore. The operation continued for about 2.5 years but was shut down in March of 1975 and active leaching has not been operated since.

The two basins are drained by recovery wells which are operated when fluid levels in the wells rise above given levels. The maximum capacities of the each pump is 225 GPM, and under extreme precipitation conditions the wells would be operated for about 2 to 4 hours at LB-6, and 3 to 8 hours per day at LB-5, before the wells draw the fluid level down to the intake and require recharging of the fluid level. The water is pumped via an 8 inch Transite pipeline to the plant site pumping facility where it is pumped to the discard solution reservoir. Again, the only waters present in the leach basins, as with the others, are the accumulated groundwater resulting from precipitation. Studies done by the McAlester Fuel Company and the Water Development Corporation of Tucson, Arizona in 1981 estimated the total capacity of LB-5 at 582,823 cubic feet or 4,359,500 gallons, and LB-6 at 1,489,954 cubic feet or 11,144,850 gallons. As the fluid levels have been maintained at approximately 35 feet below the collar of the well in LB-5 and 135 feet below the collar of the well in LB-6, the average volume held in the basins since 1980 is estimated at 3,445,038 gallons in LB-5 and 5,637,063 gallons in LB-6.

The estimated volume of a 10 year storm event on the watershed of LB-5 would amount to 928,025 gallons and a 100 year storm would create 1,305,035 gallons of runoff. The volume of a 10 year storm event on the watershed of LB-6 would create 414,480 gallons of runoff and 582,870 gallons for a 100 year storm event.

LB-6 has no mine facilities within its watershed except access roads, while LB-5 lies below the eastern end of the former open pit. The runoff from the open pit is diverted around LB-5 by means of a diversion ditch along the eastern side of the leach basin. The estimated runoff for LB-5 therefore includes the area of the leach basin only.

b) UNDERDRAIN COLLECTION SYSTEM

As outlined above, the heap leach basins at the Zonia Mine site were constructed using perforated pipe underdrain collection systems to capture and transport solutions which percolated through the leach heaps. These collection systems are still in use to capture accumulations of rain and snowmelt which are trapped in the leach piles. As built construction specifications for each of the basins have not been located in the mine records, but a preliminary design plan for leach basin LB-1 shows an underdrain collection pipeline and trench constructed in the bottom of the asphalt lined basin, with the basin divided by six foot high dams, to divert the leachate into the underdrain system. The pipelines leading from leach basins LB-1, LB-7 and LB-9 are connected to the underdrain collection system and the solutions flow by gravity to the collection pond at the plant site. Leach basin LB-1 has an 8 inch transite line draining the basin. Leach basin LB-7 has an 8 inch PVC line draining the basin and is connected to the 8 inch line draining LB-9. The maximum flows which may be handled by each system are dependent upon the diameter, layout, and solution head exerted upon each system. From available mine production records LB-1 delivered approximately 275 gallons per minute, and LB-7 and LB-9 delivered about 350 gallons per minute. Additional data concerning the construction and layout of the pipeline, if available, is required before more definitive figures for total capacity of the system can be calculated.

c) TREATMENT FACILITY

There is no treatment facility at the Zonia Mine for removal of contaminants from the waters which are collected from the mine site and leach basins. The solutions which are collected from the mine site are stored in the discard solution reservoir where evaporation of the water maintains a balance on the water level.

3. ASSESSMENT OF PAST DISCHARGES

There have been no known discharges of process water or wastewater from the Zonia Mine since the inception of Antioch Resources Inc. involvement with the property (November 21, 1983).

MAP ATTACHED TO ORIGINAL COPIES

ANTIOCH RESOURCES INC.

ZONIA PROJECT
YAVAPAI COUNTY, ARIZONA
EXHIBIT A: PROPERTY BOUNDARY, MINE
FACILITIES, SURFACE WATERS & WATERSHED

SCALE	DATE	PROJECT NO.	MAP NO.
1" = 1000'	4/12/86		
DRAWN BY	CHECKED BY	REVISED	
S.H.	D.H.		