Rio Algom Mining LLC

January 28, 2005

Via FEDEX Next Day Delivery

ADDRESSEE ONLY
Gary Janosko, Chief
Fuel Cycle Facilities Branch, NMSS
Mail Stop T-8A33
U.S. Nuclear Regulatory Commission
Washington, DC 20850

Subject: **Rio Algom Mining, LLC; Docket 40-8905**
Response to Request for Additional Information for the Closure Plan – Lined Evaporation Ponds at Rio Algom Mining LLC's Ambrosia Lake Facility (TAC LU0070)

Dear Mr. Janosko,

Rio Algom Mining, LLC (RAM) has reviewed your request for additional information (RAI) concerning the closure plan for lined evaporation ponds at the Ambrosia Lake Facility. Your RAI provided an option for RAM to request a conditional approval of the closure plan to allow relocation of the pond materials to begin prior to the Staff approving the Final Status Survey Plan (FSS), which is contained in the Soil Decommissioning Plan submitted to NRC on January 19, 2005.

As discussed with the NRC during a conference call in October 2004, RAM does not want the relocation of evaporation pond materials to be held captive awaiting review and approval of the Soil Decommissioning Plan, which includes the FSS Plan. The Staff acknowledged this concern during the call and expressed a willingness to move the process along to accommodate RAMs concerns. This was evidenced by the provision of a conditional approval within your RAI. Consistent with RAMs request to separate the two distinct tasks of relocation of evaporation pond materials from the FSS requirements, please find enclosed a response to your RAI that provides this separation of the tasks. The original submittal has been revised to remove reference to the final status survey and the Soils Decommissioning Plan, and a copy of the revised relocation plan is included with this submittal.

P.O. Box 218, Grants, NM USA 87020 - Tel: 505.287.8851 - Fax: 505.285.5550

NMSS01

With this letter, RAM requests that NRC authorize a conditional approval that would allow site work to begin upon NRC approval of the relocation plan contained herein. RAM understands that this conditional approval would not include authorization to perform final radiological measurements or backfill until the NRC approves a FSS Plan, which is included in the Soil Decommissioning Plan.

Please contact me at 505 287 8851, extension 205 if you have questions or wish to discuss this matter.

Regards,

Peter Luthiger
Manager, Radiation Safety
and Environmental Affairs

Attachment: As stated

xc: J. Caverly (NRC)
T. Fletcher
B. Law
File

RIO ALGOM MINING COMPANY'S RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION FOR THE CLOSURE PLAN -LINED EVAPORATION PONDS AT RIO ALGOM MINING LLC'S AMBROSIA LAKE FACILITY (TAC LU0070)

Rio Algom understands that the NRC will require additional information to approve final closure of the Lined Evaporation Ponds at Ambrosia Lake and that information is forthcoming. However, per your letter of December 22, 2004, Rio Algom elects to request a conditional approval of the enclosed *Relocation Plan for Lined Evaporation Ponds* (January 2005, replacing *Closure Plan for Lined Evaporation Pond* – October 2004), without inclusion of required final radiological measurements or backfill, until an updated Final Site Survey Plan has been approved. Thus, discussion of and response to questions regarding methods for verifying that all appropriate material has been removed, are deferred to subsequent documents. This response focuses on requests for additional information on issues other than those required for verification methods.

As indicated above, Rio Algom requests conditional approval of the Lined Evaporation Pond Plan to allow Rio Algom to initiate relocation of the pond materials and associated soils to the Pond 2 disposal area. This conditional approval would not authorize performing final radiological measurements or backfill of the lined pond area until NRC approval is received for the final site survey plan.

SECTION 2 – Environmental Setting

Request: ***Provide any State map or other source to substantiate the location and use of these specific drainage channels for mine drainage.***

Comparison of 1957 and 1980 Topographic Maps

Figure 1 depicts portions of the Ambrosia Lake and San Lucas Dam, New Mexico topographic quadrangle maps, published at a scale of 1:24000 by the U.S. Geological Survey (USGS) in 1957 - before large-scale mining and milling in the

Ambrosia Lake valley began. They were revised in 1980 using aerial photography, with revisions shown in purple.

Elevation data is presented in twenty-foot contour intervals, defining ridges and adjacent ephemeral drainage channels that flow from cliffs below San Mateo Mesa in the eastern portion of the map toward Arroyo del Puerto in the southwestern portion. Note that Voght Tank was already present in 1957, but mines and mills are shown in purple, indicating that they were not present in 1957.

The 1980 map revisions include a series of mine ponds in T14N R9E, Sections 34 and 35, and water collection ponds with an associated perennial stream in T13N R9E Section 3. The stream arises in T13N R9E Section 2, down gradient of mine ponds at the point of the ridge in T14N R9E, Section 35. This evidence from the USGS indicates that, at some time in the interval between 1957 and 1978, a number of ponds and streams were established that, in 1980, were judged to contain water on a year round basis.

The perennial stream issuing from a mine pond in Section 2 flows directly west to join an intermittent stream issuing from Voght Tank. The combined stream channel flows southwest, through the future location of Section 4 Ponds. Even though perennial flow from mine ponds extends to Section 4, flow from the confluence of the two channels down to the intersection of Arroyo del Puerto is defined by a dashed line symbol designating an ephemeral channel.

Transition from perennial to ephemeral flow is common in arid regions where water either evaporates, leaving its associated chemical constituents on the surface (in this case, beneath the future Section 4 Ponds), or it can infiltrate into the subsurface, carrying its chemical constituents with it. In either case, suspended sediments and relatively insoluble dissolved constituents (for example, thorium and radium) are enriched in the vadose zone between the surface and the water table.

Mines Contributing to Flow

Since some of the water from ponds in Section 3 flows south (SE corner Sec 3 T13N R9W), the northern branch of this system marks the southern-most drainage that flows though Section 4. A prominent channel extending from near the Section 33 Mine down to the northwest corner of Pond 11 (Figure 1), marks the northern-most drainage flowing through the area now occupied by the Ponds. Thus, all streams between the two drainages are constrained to flow to channels adjacent to and beneath the Section 4 Ponds.

A document prepared by the New Mexico Health and Environment Department (NMHED) (currently New Mexico Environment Department) titled "*Water Quality Data for Discharges From Uranium Mines and Mills in New Mexico* " (Goad, et al, 1980) lists water production from New Mexico uranium mines that were active in November 1979. Sixteen of the active mines were in the Ambrosia Lake Valley. Six of these (mines in Sections 27, 28, 33, 34, 35, and 36), are located entirely or partly in drainage systems that flow through the Section 4 Pond area, as illustrated in Figures 1 and 2 (compare to Figure 2-3 of the Closure Plan). Rio Algom would like to note the following errors/omissions on Figure 2-3 of the Rio Algom's October 2004 Closure Plan:

1. The mine in Section 27 is not shown,
2. The mine in Section 33 is shown approximately 3500 feet west of its true location.

Goad, et. al (1980) state that "*Specific determination of water quality in the western and central portions of the Ambrosia Lake area is in some cases not possible because of the intermingling of several mine discharges together.*" However, in 1977, NMHED collected a sample of discharge to an arroyo *'near ... the old Phillips millsite*" and analyzed it for various parameters. Results included the following constituent concentrations (Table 1).

Table 1. Selected Constituent Concentrations From Analysis Of A Sample Of Discharge To An Arroyo

Uranium	0.32 mg/L,
Radium-226	29+/-1 pCi/L
Lead-210	17+/-6 pCi/L.

Discharge was from a pond containing water pumped from the mines in Section 27, and 34. Total discharge in 1979 was estimated to be approximately 190 gpm. They report sampling the pond in 1978 and 1979 with results as reported in Table 2.

Table 2. Selected Constituent Concentrations From Analysis Of Samples Taken From the Last Pond Before Discharge (Ann Lee, Section 27, and Sandstone Mines)

	1978	1979
Uranium	2.32 mg/L,	1.31 mg/L
Radium-226	65+/-1 pCi/L	19+/-6 pCi/L
Gross Alpha	570+/-70 pCi/L	360+/-60 pCi/L

Goad, et. al, (1980) report that the mines in Sections 35 and 36, each discharged 1300-1600 gpm during 1977-1978 to common settling ponds (purple areas in Section 35 at the point of the ridge, just west of the mine in Section 36 shown on Figure 1). Pumped mine water was treated with barium chloride to lower radium concentrations and then discharged to the arroyo [resulting in the areas of dark, anomalous vegetation in the arroyos south and west of the mines in Sections 35 and 36, observed on the 1977 aerial photograph (Figure 2-3)]. Goad et. al, (1980) report sampling outfalls from the ponds in 1977, 1978, and 1979 with results as reported in Table 3.

Table 3. Selected Constituent Concentrations From Analysis Of Samples Taken From the Last Pond Before Discharge [Section 35 and Section 36 (Cliffside) Mines]

	1977	1978	1979
Uranium	1.1 mg/L,	1.2 mg/L,	0.39 mg/L
Radium-226	2.3+/-0.8 pCi/L	2.1+/-0.2 pCi/L	1.4+/-0.4 pCi/L
Gross Alpha	---	270+/-40 pCi/L	54+/-14 pCi/L

Concentration of Mine Drainage-Related Constituents in Soils at Section 4 Ponds

It should be noted that there are geochemical processes causing certain constituents to be concentrated at various locations along the flow path of discharge water. Transport of relatively insoluble constituents such as radium and thorium is likely to be strongly influenced by the presence of colloidal suspensions. Colloids can be suspended in, and transported by, surface water, but they tend to be left at the surface or the near subsurface when surface water infiltrates towards groundwater. Therefore, constituents that are adsorbed on colloidal particles are enriched in the near surface sediments at locations where infiltration of surface water has occurred over time, such as within the drainages through Section 4.

Even low concentrations of such constituents in surface water can lead to high concentrations in surface sediments if a large volume of water infiltrates. A good discussion of this phenomenon can be found in an NMHED publication "Impacts of Uranium Mining on Surface and Shallow Ground Waters, Grants Mineral Belt, New Mexico" (Gallaher and Cary, 1986), which also points out that natural runoff from uranium mineralized areas such as those in the Ambrosia Lake vicinity, and runoff from mine waste piles can have a substantial impact on surface water quality and sediments in ephemeral drainages.

Gallaher and Cary (1986) gathered data from active mines at Ambrosia Lake during the period 1977-1982 and performed a statistical analysis of concentrations of constituents in samples of treated mine water just prior to discharge. Table 4 is a reproduction of their Table 7.3 for Ambrosia Lake.

Table 4. Quality of Treated Minewater at Active Mines, 1977-1982. All data reflect total concentrations in grab samples collected by NMED-EID personnel.

CONSTITUENT	AMBROSIA LAKE MINING DISTRICT				
	MAX	MIN	MEDIAN	AVG	# of Samples
TDS (mg/L)	2,615	510	1,610	1,440	26
SO4 (mg/L)	1,370	185	775	655	22
As (mg/L)	0.2	<0.005	0.011	0.02	26
Ba (mg/L)	1.7	0.1	0.21	0.24	
Mo (mg/L)	3.2	0.03	0.8	1	27
Se (mg/L)	1	0.01	0.09	0.24	27
Unat (mg/L)	3	0.2	1.56	1.5	26
V (mg/L)	0.29	<0.01	0.029	0.08	21
Gross Alpha (pCi/L)	1,760	54	635	780	14
Gross Beta (pCi/L)	945	84	377	435	6
Pb-210 (pCi/L)	33	6.9	14	15	9
Po-210 (pCi/L)	14	0.95	1.1	6	4
Ra-226 (pCi/L)	200	0.12	6.4	27	28
Ra-228 (pCi/L)	0	0	0	0	5
Th-228 (pCi/L)	<0.3	<0.1	<0.1	0.2	3
Th-230 (pCi/L)	4	<0.3	0.7	1.7	3
Th-232 (pCi/L)	<0.1	<0.1	<0.1	<0.1	3

NMHED also collected samples of mine waste piles for tests modified from the Synthetic Precipitation Leaching Procedure (SPLP) to “simulate the leaching effects of natural rainfall after contacting alkaline rich soils common to the Grants Mineral Belt”. Table 5, below, is taken from their Table 5.1. These are the concentrations that would be expected to flow through Section 4 during and after rainfall events.

Table 5. Total Contaminant Concentrations in Ambrosia Lake Waste Pile Runoff

CONSTITUENT	Mine Waste Runoff		
	RANGE	MEDIAN	# of Samples
As (mg/L)	<0.005-1.5	<0.005	15
Ba (mg/L)	0.18-37.5	5.9	15
Cd (mg/L	<0.001-0.02	0.006	15
Pb (mg/L)	0.02-2.5	0.56	15
Mo (mg/L)	<0.001-3.2	0.02	15
Se (mg/L)	<0.005-0.85	0.03	15
Unat (mg/L)	0.04-62.5	0.58	15
V (mg/L)	0.04-24.8	1.1	15
Zn (mg/L)	<0.05-4.4	1.7	15
Gross Alpha (pCi/L)	300-420,000	10,800	15
Gross Beta (pCi/L)	177-168,000	6,700	15
Pb-210 (pCi/L)	29-30,050	1,000	6
Ra-226 (pCi/L)	1-34,900	650	6

Summary

Publications by NMHED (Goad, et al, 1980, Bostik, 1985, and Gallaher and Cary, 1986), the New Mexico Bureau of Mines and Mineral Resources (Stone et. al., 1983), and the USGS (Ambrosia Lake and San Lucas Dam, New Mexico topographic quadrangle maps) have documented the discharge of poor quality mine water to ephemeral drainage channels that flow through the area that currently underlies Section 4 Ponds. Aerial photographs depict the presence of vegetation that arose during the extended period that mine discharge occurred. Recent aerial photographs indicate that vegetation in channels is dying or dead, reflecting the lack of water in the Section 4 drainage.

Well known geochemical processes (see for example Gallaher and Cary, 1986) attenuate thorium and radium on the surface or in the near subsurface, thereby concentrating these radionuclides in near surface soils. Even low concentrations of such constituents in mine discharge water can lead to high concentrations in surface sediments if a large volume of water infiltrates/evaporates. The publications listed above have documented that a large volume of mine discharge water flowed to the location of the current Section 4 Ponds. A large portion of this water infiltrated and or evaporated before it reached the Arroyo del Puerto, indicating that a large mass of constituents of concern are now present in soils beneath the Section 4 Ponds that is unrelated to seepage from the ponds. It is likely that a large percentage of this mass was in place prior to the existence of the ponds.

Request: Provide a map of the gamma survey results with individual color points visible and an explanation of the gamma range represented by each color. Also, describe the Voght tank.

Gamma radiation surveys performed as part of the DOE UMTRA surface reclamation at the former UNC (Phillips) Mill, identified elevated radiation levels within the drainages into and out of Voght Tank. DOE included these drainages, down to and including Voght Tank sediments, within the site cleanup plan; but the dam and drainages downstream from Voght Tank were not included in the DOE site cleanup plan.

Rio Algom performed preliminary characterization surveys to support the visual evidence of impacts attributable to the mine dewatering activities that flowed to and through the Section 4 area prior to pond construction. Presentation of this information (Figure Gamma map #) is intended to support this contention.

As was previously discussed, Voght Tank existed prior to commencement of mining activities in the Ambrosia Lake area. Voght Tank is a manmade stock tank that was subsequently used as the collection point for surface waters entering the UNC mine/mill complex canal system (Section 28 T14N R9W) (Figures 1 and 2). Field observations indicate that the Voght Tank earthen dam contains waste rock materials that exhibit elevated radiation levels, indicating that the berm of the tank was enlarged following mining activities, likely to contain the additional water supplied by the mine dewatering activities. The stock tank has not been used in the recent past and only receives water as surface runoff as a direct result of precipitation.

SECTION 4 – Surface Reclamation Plan

Request: Clarify that the proposed methods (e.g., seed type and rate) meet State Regulations.

The seed mix and seeding rates proposed for the lined pond area were developed in consultation with the U.S. Soil Conservation Service (now the Natural Resource Conservation Service), and has been approved by New Mexico Mining and Minerals Division Mining Act Reclamation Program for use within the overall mine closure plan. A copy of this permit, including the approved revegetation plan (Section 5 Item R), is attached.

Among factors considered in developing the methods are: the known drought conditions that exist in much of the Southwest, the high climatic variability in New Mexico, post reclamation land use, and selection of species that are appropriate for the site. A number of species are either native or currently established at the site (i.e., Blue Grama, Indian Ricegrass, Winterfat, Sand Dropseed, and Fourwing Saltbush) (see the attached *Biological Survey Memorandum for the KGL Haul Road Project, Milan, McKinley County, New Mexico*). Other species (for example, Native Western Wheatgrass and Sideoats Gramma) are considered desirable for the approved post reclamation land use (grazing).

SECTION 6 – Health & Safety & Environment

Request: Indicate where these (wash water) cells will be located and where the closure of these cells is discussed.

Decontamination of equipment will occur within the footprint of the existing ponds thereby containing any wash water generated during decontamination activities. The contractor intends to carefully remove all pond sediment material above the liner in an area on one pond and will construct a wash station at this location on top of the liner. Equipment will be washed at this location and the water will collect and flow toward a low point within this lined area where it will be pumped into another pond to be mixed with dry materials prior to transport to Pond 2. This design will prevent any wash water from entering the subsurface. The wash down areas may be established within multiple ponds to facilitate decontamination activities.

The wash areas will be closed by simply removing any remaining standing water and using a loader or other heavy equipment to scrape up the liner and transport the material to Pond 2 for disposal.

SECTION 7 – Reclamation Costs

Request: Provide third party costs for labor, soil analysis, etc.

As part of the request from NRC to recalculate the site financial assurance, Rio Algom included the Section 4 Ponds and Pond 9 project within this scope.

A total cost estimate of $9,201,000 was calculated for the relocation project. This cost does not include costs to construct the design cover over the relocated sediments nor the costs associated with performing final status survey activities. Costs presented within this response are solely associated with the relocation project, and are included within the revised financial assurance calculation for the site submitted to NRC in January 2005.

The following table summarizes the cost estimates for the Section 4 Ponds and Pond 9 project. Also provided within Appendix B are the pertinent portions of the signed contract between Rio Algom and the contractor (KGL and Associates) charged to perform the relocation project along with cost estimates for third party radiation surveys and laboratory analysis.

Cost Estimate for the Decommissioning of the Lined Evaporation Ponds		
Work Area	**Estimated Cost**	**Basis**
1. Mobilization	$1,000,000	3rd Party Contractor Bid
2. Road Crossing Construction	$403,000	3rd Party Contractor Bid
3. Sediment/Berm Removal (Section 4)	$7,500,000	3rd Party Contractor Bid
4. Re-contouring and Revegetation (Section 4)	$230,000	3rd Party Contractor Bid
5. Pipeline Removal	$6,800	3rd Party Contractor Bid
Total Costs:	**$9,201,000**	

ENVIRONMENTAL REVIEW REQUIREMENTS

Request: ***The U.S. Fish and Wildlife Service has listed the Mexican Spotted Owl, the Southwester Willow Flycatcher, and the Zuni Fleabane as threatened and endangered animals in McKinley County, NM. Please address the impacts of the proposed action on the above noted species including its habitat.***

While several listed Endangered, Threatened and Species of Concern potentially reside in McKinley County, land in the vicinity of Rio Algom's mill site does not contain suitable habitat to attract colonization by any of these species. For example, it lacks the coniferous woodland habitat suitable for the Mexican Spotted Owl (attached document Marron and Associates, 2004). The Southwestern Willow Flycatcher prefers a riparian habitat and the only riparian habitat within Section 4, the wetland created by mine dewatering, lacks suitable overstory structure. Zuni Fleabane grows in selenium-rich red or gray detrital clay soils derived from the Chinle and Baca Formations. These geologic units do not crop out in Ambrosia Lake Valley and, therefore, suitable habitat for the Zuni Fleabane does not exist in Section 4. The biological studies referenced above support Rio algom's contention that the relocation project will not adversely affect the public or environment, including threatened and endangered species.

Request: ***The duration and schedule will affect the impacts to the site and should be considered in the EA. Please provide details regarding the phases and duration of the proposed action.***

To the extent possible, project phases will be conducted concurrently, allowing Rio Algom to minimize project duration and reduce overall impacts. It is anticipated that the total time required to complete the relocation project phases listed below will be approximately 12 months.

<u>Mobilization Phase</u> Setup of equipment maintenance areas, staging areas, and haul roads is on-going. Remaining work elements include installation of power and water to the pond area, delivery and activation of mobile office, supply, and

shower/changeroom trailers. Completion of these tasks will occur prior to commencement of any transport to Pond 2.

Road Crossing Construction Phase Materials to construct the road crossing have been arriving at the site. Construction of the crossing is anticipated to start in February 2005 and is expected to be complete by May 2005.

Sediment/Berm Removal Phase Consolidation of pond materials is currently in progress and the truck haul is scheduled to begin in May 2005 following completion of the road crossing. The actual haul phase is expected to take 12 months.

Impacted Soil Removal Phase This work will begin as soon as the liner can be removed from the first pond to be cleared of pond sediments and will be concurrent with sediment/berm removal.

Restoration of Pond Areas Phase This phase will be deferred until approval of the Final Site Survey Plan. It is Rio Algom's intent to minimize residual soil contamination in areas where the pond and berm/soil materials have been removed so that potential personnel and/or environmental exposure concerns are minimized.

Request: Please provide details of measures that will be employed to control surface water runoff, traffic control and safety, dispersion of radiological material, and infiltration of contaminated water into groundwater systems.

The Section 4 Ponds drainage is protected by existing National Pollutant Discharge Elimination System (NPDES) Surface Water Discharge Permit Number NM0020532 and New Mexico Water Quality Act Groundwater Discharge Permit DP-71. Rio Algom has, and will, adhere to these Federal and State requirements.

All surface water on Section 4 flows toward Arroyo del Puerto in the channel adjacent to the ponds. It is anticipated that excavation will proceed from the upgradient ponds and work toward Arroyo del Puerto. Berms and liners will remain in place until pond sediments are consolidated or removed to ensure that no pond fluids will escape outside of the pond footprint.

To reduce potential for contamination by pond sediment material during relocation, contamination surveys will be performed along the travel route prior to commencement of activities and monthly during hauling operations. Additional surveys will be performed if any spillage is discovered and appropriate corrective actions will be implemented. Haul roads will be designed using best management practices to control runoff .

The primary radiological hazard that may be encountered during lined pond removal is residual radioactive materials that could become airborne. Appropriate contamination control practices will be implemented to minimize the potential for spreading and tracking contamination out of the active work areas. Examples of these control practices include removal of additional soils below the liners and dust control practices on haul roads. Rio Algom will install and operate two continuous particulate air monitoring samplers in the vicinity of the Section 4 Ponds. These samplers will be incorporated into the existing air environmental monitoring program and will be operated for the duration of the lined pond relocation activities.

Traffic control is a part of the project design, which minimizes the potential for traffic accidents occurring by using dedicated haul roads to maintain segregation of traffic. Hazards to the general public are minimized by the construction of an overpass across the public highway and restricting access. The overpass design will be approved by the New Mexico Department of Transportation and will incorporate additional safety measures to minimize the potential for transportation incidents including fortified berms and installation of a divider barrier to separate and isolate the traffic lanes across the road crossing.

Request: Please provide information and requirements for permits required for work to be completed across the state highway.

The NMDOT has given written approval to a categorical exclusion assessment for construction of the crossing and has submitted an assurance to the Federal Transit Administration (FTA) that the project is categorically excluded under FTA's regulations. The completed Categorical Exclusion Form and supporting documentation can be found in Appendix F of the Relocation Plan.

Request. ***Explain how cultural sites will be protected from the impacts of large construction processes during the duration of the proposed project.***

Rio Algom has conducted numerous cultural resources surveys in the vicinity of the mill area. An additional Cultural Resource Survey (see attached *Class III Survey of 18.58 Hectares (45.91 Acres) for Rio Algom Mining LLC, Near Ambrosia Lake, McKinley County, New Mexico*) conducted by Ecosystem Management, Inc., and completed in September 2004, identified a total of eight isolated occurrences (IO's). These eight features consisted of three separate isolated occurrences of a fragment of sandstone tool and five separate isolated occurrences of a fragment of pottery. Although the survey concluded that no significant cultural resources were identified, Rio Algom does not intent to disturb any area identified within these surveys.

ATTACHMENTS

TASK --> **Section 4 Pond Reclamation**

Costs associated with the Section 4 Pond closure have been provided through a contractor bid, which was executed within a signed contract between Rio Algom and contractor. The bid includes costs associated with construction of the final disposal cell on Pond 2, including erosion protection.

The prices are for discrete work elements as well as unit rates for other tasks. A copy of the cost schedule is included and is summarized below.

Fixed price	Item
1000000	mobilization
403000	highway crossing
7500000	Removal and transport of materials to Pond 2
6800	removal of pipeline
230000	revegetation of section 4 area
9139800	Subtotal on fixed price elements

Pond 9 closure costs

Pond 9 sediment removal was bid by contractor (KGL) as part of the Section 4 project.

Total Cost	Unit Cost	Quantity	Item
0	-	-	Mobilization (already addressed in Section 4 costs)
312400	2	156200	Unit cost to relocate sediments/contaminated berms to Pond 2 ($/yd). Based on sediment thickness data, 6" below liner, and berm materials
312400			Total cost to relocate materials

Revegetation of Pond Area

Revegtation costs based on KGL bid provided for construction of Pond 1 south toe.
KGL revegetation costs per acre were --> 1100

40	Area requiring revegetation (acres)
1100	Cost per acre ($/acre)
44000	Revegtation cost

Appendix A

Scope of Work

Article I.

Contractor shall remove all fluids, sludge, slimes, sand, evaporate crystal, debris, and other materials above the liners and including the liners (the "Materials") from the eleven Section 4 ponds. In addition, Contractor shall remove contaminated berms (not to exceed 264,583 cy) and soil to an average depth (across all eleven Section 4 ponds) of six inches beneath the liners, not to exceed 206,500 cubic yards (the "Soil"). Contractor shall transport and deposit the Materials and the Soil to Pond 2. Contractor shall remove the Materials and the liner exposing at least 25% of the pond area below the liner. Company shall perform a visual inspection/radiation survey and direct Contractor whether or not to remove any Soil from below the liner. Company shall provide such direction within two working days of Contractor notifying Company that a pond excavation has progressed to the point that at least 25% of the pond area below the liner is exposed. In the event that the Company's inspection/radiation survey identifies contaminated material beneath the liners or within the berms, Contractor shall remove such material. In the event that Company directs Contractor to remove Soil below the liner, Company may direct Contractor to remove Soil to a depth of 6" or more below such liner. Contractor shall not be required to remove more than 264,583 cubic yards of berm material or more than 206,500 cubic yards of soil below the pond liners without additional compensation at the unit rates specified in Article II (3)(a) and (b); in the event that Company directs removal of fewer than 264,583 cubic yards of berm material or fewer than 206,500 cubic yards of soil, there shall be no downward price adjustment.

Prior to its transportation of the Materials and Soil to Pond 2, Contractor shall mix and consolidate the Materials and Soil to a consistency amenable to hauling without spillage enroute, and then haul the Materials and Soil in CAT 773 trucks or equivalent, subject to approval by the Company, which shall not be unreasonably withheld, from Section 4 across State Highway 509 via an under/overpass to the Pond 2 disposal area for placement and compaction. Contractor shall further consolidate the Materials and Soil at the Pond 2 location as necessary to meet the compaction specification. All materials placed onto Pond 2 shall be compacted in accordance with the specifications provided in Article II.(1)(c) and (d).

The locations of the Pond 2 disposal area and the proposed haul routes from Section 4 to the Pond 2 disposal area are all depicted in Appendix D. All traffic for the haul will be managed on dedicated haul roads and across State Highway 509 via an underpass or overpass as depicted on Appendix D. All traffic management will be coordinated between the Company and Contractor.

The Company estimates the capacity required for all Materials and Soil, together with additions thereto to be 1,600,000 cubic yards. The Company has estimated the overall capacity available in the uncovered portion at the north end of Pond 2 where the compacted Materials and Soil will be taken to be approximately 1,000,000 cubic yards. The Company has estimated additional capacity of 600,000 cubic yards to be available south of the unrocked portion of Pond 2 to the ridgeline. If the additional capacity is needed, Company shall remove the rock cover currently placed on this portion of Pond 2, and Contractor shall then place the Materials and Soil with additions thereto in the vacated area, and Contractor shall then replace the removed rock in accordance with Appendix F at the unit rate provided in Article II.(2)(b). If additional capacity, after evaporation and compaction, is required, Company shall remove the rock cover currently placed on the southern part of Pond 2, Contractor shall then place the Materials and Soil with additions thereto in the vacated area, and Contractor shall then replace the removed rock in accordance with Appendix F at the unit rate provided in Article II.(2)(b).

Contractor shall commence the foregoing operations on the Section 4 Ponds in a manner and sequence that controls traffic patterns and ensures that contamination is contained to prevent cross-contamination. Contractor shall conduct removal of evaporate and the liner at the Section 4 Ponds in a manner that prevents the release of any pond liquids into any unprotected surface area. Contractor shall conduct evaporate mixing with amendment materials in each Section 4 Pond located on top of the PVC liner in a manner that prevents the release of amended materials onto any uncontaminated surface area.

Contractor shall install a clay/soil cover on Pond 2 with Company provided material and shall compact the Company provided material in accordance with the specifications provided in Article (II)(1)(d) herein. The Company will make available to Contractor amendment material at a borrow area approximately one mile north east of Pond 2, and cover material at the clay borrow area adjacent and south of Pond 2. The Company will supply rock to Contractor at a location adjacent to Pond 2, which Contractor will then use to place the rock armor covering on the cover, apron, and drainage channels in accordance with NUREG-1623 Appendix F, Rock Placement Procedures for Erosion Protection, included as Appendix F to this Agreement.

Following soil verification by Company, Contractor shall grade the Section 4 Ponds' areas, pushing in the remaining uncontaminated berms to achieve positive drainage. Contractor shall provide surveying control, with support from a licensed surveyor to provide back up and check points at critical junctures, calculating the amount of Soil that has been removed below the pond liners, calculating the removal of impacted berm material, and for as-built survey and as-built drawing preparation support. Contractor shall also provide QA/QC technicians, under the oversight of Contractor's QA/QC engineer, who will perform their QA/QC tests in the field to meet the requirements of Article II(1)(d). Contractor shall also provide Health Physics (HP) support for the Company's radiological monitoring program. Contractor's HP support will be performed under the direction of the Company's Radiation Safety Officer.

Contractor shall complete the work described herein in accordance with the schedule provided in Appendix E herein, subject to adjustment as provided in this Agreement. This schedule is based on a Work Start Date of August 1, 2004 and to the extent the Work Start Date is extended later than August 1, 2004, all of the remaining interim dates and the final date shall be extended accordingly.

Article II. (1) Work for Fixed Price

(a) Mobilization and transportation of Contractor's equipment and personnel in connection with the Work. ($1,000,000)

(b) Construction of a highway crossing (either underpass or overpass) at the location depicted on the schematic attached hereto as Appendix D, which complies with applicable law and meets the standards of the New Mexico Department of Transportation (NMDT) on Highway 509 and removal of same. ($403,000)

(c) Removal of all Materials and Soil in the Section 4 Ponds, and haulage of same to Pond 2 where this material will be placed and compacted in one-foot lifts to meet 90% proctor at optimum moisture (±3%). Section 4 pond materials to include all materials above the liners (including the liners), a total of up to 264,583 cy of contaminated berm materials, and up to 206,500 cy of Soil below the liners ($7,500,000)

(d) Soil testing (QA/QC) on the compacted amended and cover material shall be performed every 1000 cy to verify that amended material was compacted to meet 90% proctor at optimum moisture (±3%), and cover material was compacted to meet 95% proctor at optimum moisture (±2%). ($550,000)

(e) The Company will clear the path for the haul road. Contractor will be responsible for preparing, upgrading and maintaining the haul road. (Not separately priced.)

(f) Excavation, removal and transportation to Pond 2 of 8,150 linear feet of 8-inch PVC pipeline from the area depicted on the schematic attached hereto as Appendix D. Company shall perform a visual inspection and verification sampling and may direct Contractor to excavate contaminated soil at the unit price provided in Article (3)(a) herein. ($6,800)

(g) Restoring and reseeding of all disturbed areas including Section 4 ponds staging areas, haul roads, former pipeline location, borrow sites, and other infrastructure used by the contractor directly or in support of the contract work (estimated to be 450 acres). The restoring and reseeding shall be performed in accordance with the specifications included as Appendix G herein. ($230,000)

Subtotal Fixed Price	$9,689,800

(2) Cover Placement at Pond 2, of Company provided clay/soil material and rock:

(a) Cover placement on Pond 2[2]	300,000 cy [1]	$2.50/cy	$750,000
(b). Rock placement on Pond 2	54,000 cy [1]	$1.90/cy	$102,600
Subtotal			$852,600
Total fixed price bid, plus estimated cover/rock replacement (excluding NM use tax)			$10,542,400

[1] Estimated quantities. Contractor will charge at its unit rates for clay and rock cover actually placed.

[2] Cover to be placed in 6-inch lifts

(3) Additional Work at Unit Rates:	Unit Rate $/Bank Cu. Yd.
(a) Excavation and haulage to Pond 2 of berm material to the extent that contamination exceeds 264,583cy [1] [2]	3.50
(b) Hauling to Pond 2 of Soil in excess of 206,500 cubic yards below the Section 4 Pond liners, provided that Company excavates this material and places it in an agreed location [1] [2]	3.00
(c) Excavation and removal of Pond 9 materials, placement and compaction in Pond 2 or Pond 3 (disposal location to be decided by Company) [2]	2.00
(d) Strip the overburden from the clay borrow site south of Pond 2 and place in currently excavated area adjacent and west of clay borrow site.	1.00

[1] To the extent that the additional contaminated material (or part thereof) in 3(a) and (b) is required by Contractor in order to achieve a consistency amenable to hauling of Section 4 Pond materials this work will be done by contractor without charge.

[2] Material to be compacted to meet 90% proctor at optimum moisture (±3%).

Cultural Resource Survey

Class III Survey of 18.58 Hectares (45.91 Acres) for Rio Algom Mining LLC, Near Ambrosia Lake, McKinley County, New Mexico

Prepared by
Richard Burleson

Under

BLM Permit Number 157-2920-03-E
New Mexico State Land Permit Number NM-04-107

NMCRIS NO. 89898

Organization
Ecosystem Management, Inc.
4004 Carlisle NE, Suite C1
Albuquerque, New Mexico 87107
(505) 884-8300
FAX (505) 884-8305

For
Rio Algom Mining, LLC.

EMI Report Number 612

September 2004

ABSTRACT

On August 31, 2004, Ecosystem Management, Inc. (EMI) conducted a Class I archival search and a Class III pedestrian cultural resource survey of approximately 18.58 hectares (ha) (45.91 acres [ac]) near Ambrosia Lake, McKinley County, New Mexico. The project is located within Township 14 North, Range 9 West, Sections 5 and 32 on the US Geological Survey (USGS) Ambrosia Lake, NM 7.5 minute quadrangle.

A total of eight isolated occurrences (IOs) were identified and recorded during the Class III survey. Their data potential has been exhausted by the present recording. No further cultural resource investigations are recommended at this time.

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INTRODUCTION/ PROJECT DESCRIPTION

On August 31, 2004, Ecosystem Management, Inc. (EMI) conducted a Class I archival search and a Class III pedestrian cultural resource survey of approximately 18.58 hectares (ha) (45.91 acres [ac]) near Ambrosia Lake, McKinley County, New Mexico. The project is located within Township 14 North, Range 9 West, Sections 5 and 32 on the US Geological Survey (USGS) Ambrosia Lake, NM 7.5 minute quadrangle.

A total of eight isolated occurrences (IOs) were identified and recorded during the Class III survey. Their data potential has been exhausted by the present recording. No further cultural resource investigations are recommended at this time.

This undertaking complies with the provisions of the National Historic Preservation Act of 1966, as amended through 1992, and applicable regulations. The report is consistent with applicable federal and state standards for cultural resource management. The archaeological field work was completed by Richard Burleson and Robert Phippen. Richard Burleson served as principal investigator and Robert Phippen served as field director.

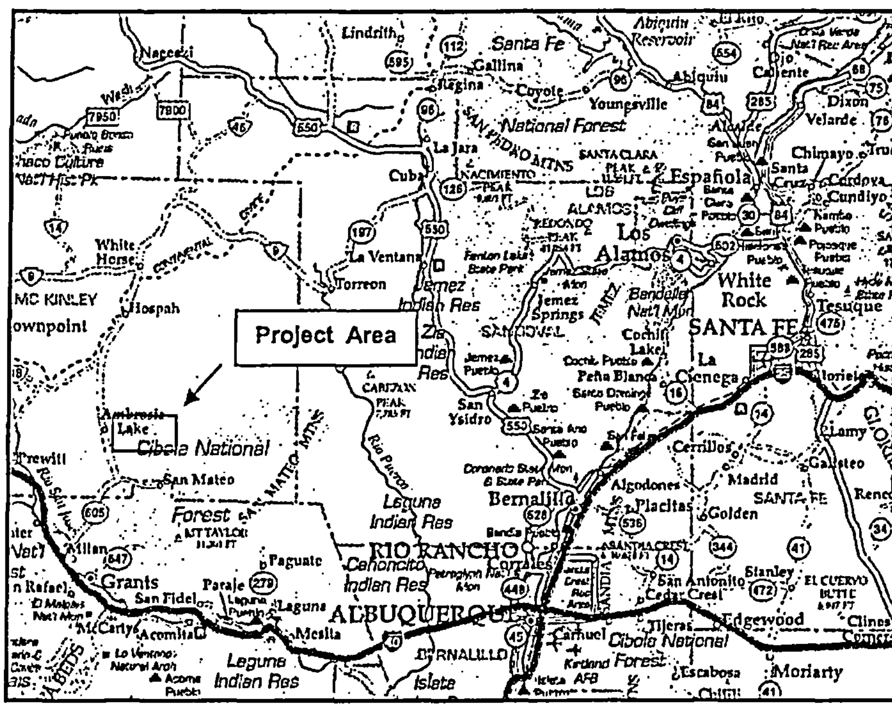

Figure 1. Project location in northwest New Mexico.
Source: Recreational Map of New Mexico, GTR Mapping (2000 Edition)

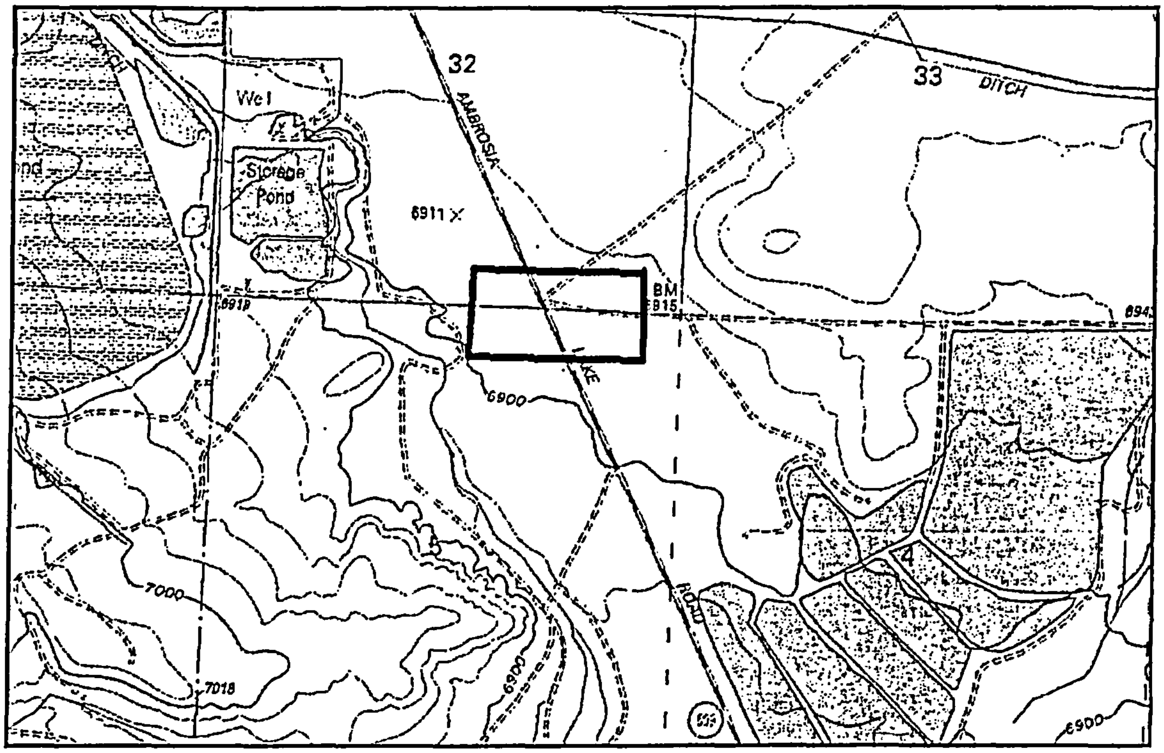

Figure 2. Ambrosia Lake 7.5-minute quadrangle showing survey area location.

ENVIRONMENTAL SETTING

Physiography

The project area is within the central portion of McKinley County in northwestern New Mexico (Figure 1). This area is in the Navajo Section of the Colorado Plateau Province of the North American continent. The Colorado Plateau is characterized by deep canyons, high altitude, steep escarpments, flat plateaus comprised of gently dipping sedimentary rocks, and an arid climate (Thornbury 1965) (Figure 3). The most distinctive structural feature of the province is its large number of monoclines. The monoclines are broken throughout the province by structural basins and up warps of considerable relief. Volcanic structures are concentrated around the plateau's margin but are also scattered throughout its interior (Kelley 1955).

The Navajo Section of the province is a poorly-defined area of scarped plateaus that lack the degree of dissection that occurs elsewhere in the province (Thornbury 1965). Surfaces in the Navajo Section are mesas, buttes, and cuestas rather than clinal ridges and hogbacks. The section is bounded on the west and south by the Little Colorado River and the Echo Cliffs monocline near the Colorado River. The northern boundary is along the lower San Juan River to the Four Corners area, then northeast to the San Juan Mountains. The southeast boundary extends from the Sierra Nacimiento to Mt. Taylor and onward to the Puerco River.

The Navajo Section has numerous volcanic features that include vents, flows, and pyroclastic deposits that are referred to collectively as the Navajo-Hopi Volcanic Field. Other major structural features of the section include the Black Mesa Basin, the Defiance Upwarp, and the San Juan Basin. The Navajo-

Hopi Volcanic Field is comprised of the Hopi Buttes, Monument Valley, and the Chuska Mountains. Basalt-capped mesas and buttes are common throughout the section (Thornbury 1965).
The exposed rocks of the Colorado Plateau range from the Precambrian to the Recent period in age (Thornbury 1965). Black Mesa is capped by the Cretaceous Mancos Shale and Mesa Verde Sandstone formations. The Defiance Upwarp has exposed the much older De Chelly Sandstone. The Navajo Section is characterized as a basin with thick layers of gently dipping Mesozoic and Cenozoic sedimentary shale, mudstone, and sandstone that contain coal seams. The area is generally characterized as rolling plains with cuestas and tablelands capped by sandstone. Canyons are typically broad and shallow (Williams 1986).

The character of the Colorado Plateau is a product of the interaction of three processes: uplift, volcanism, and erosion. Erosion is the primary force that has created the extant landscape. The tectonic event that uplifted the Colorado Plateau involved the westward movement of the North American plate, beginning about 75 million years ago. Over a period of the next 25 million years, the western portion of the North American plate broke, buckled, and was uplifted, forming the Rocky Mountains. The following 45 million years has been degradation as material has been removed from the surface of the plateau to form the Middle and Late Tertiary deposits in other regions. As recent as 10 million years ago, a large lake formed in what is now northeastern Arizona. Streams carried eroded materials from the south, east, and north. This ancient lake is referred to as Hopi Lake (Repenning et al. 1958).

As part of the plate tectonics, weak spots formed in the North American plate that allowed volcanic pipes to form, and the Hopi Buttes volcanic field was created from 8 to 4 million years ago (Wenrich 1989). Explosive eruptions ejected large quantities of tuff and basalt flows that spread outward from the vents. By the early Pleistocene, renewed uplift of the plateau had drained Lake Hopi and accelerated erosion from the province (Chronic 1983). The Colorado River was flowing through the Gulf of California by this time, with increased channel cutting. The Colorado Plateau has eroded to a greater degree than any other part of the United States (Thornbury 1965). The major drainages for the project area are Mitchell Draw that borders the east side of the project area and the headwaters of the Rio San Jose that is to the west and south of the project area. The project area elevation is approximately 6900 feet above mean sea level.

Climate

The climate is characterized as being arid to semi-arid with hot summers and mild winters. Temperatures across northwestern New Mexico vary mainly as a result of elevation and latitude. Winter temperatures drop about 1° centigrade (C) for every one-degree increment in latitude. Summer temperatures drop about 1°C for every 150 m (492.ft) increase in elevation (Sellers and Hill 1974). For Grants, New Mexico (1971 to 2000 records), the mean average summer high temperature ranges between 29° and 31° C (85° to 88° Fahrenheit [F]) and the average winter high temperature ranges between 7° and 10.5° C (46° to 51° F). The average number of frost-free days is about 120 days (Bennett 1986:38, 47).

Annual precipitation for Grants, New Mexico (1971 to 2000 records), is 25.4 centimeters (cm) (10 inches [in]). Most precipitation occurs from July through October. Average snowfall in Grants is 30.4 cm (12 in). Summer precipitation originates primarily from the Gulf of Mexico and the Atlantic Ocean. Precipitation from summer storms is brief, occurring primarily in the evening. These thunderstorms tend to be localized. Winter precipitation originates from the Pacific Ocean (Sellers and Hill 1974). Precipitation from winter storms is usually light to moderate. Most mountainous areas receive winter precipitation as snow.

The prevailing winds are from the southwest with winds from the west and southeast not uncommon. The most frequent wind velocities range between 13 and 19 km per hour (8 to 12 mi per hour) from March through June, with the predominate direction being from the southwest (Bennett 1986:50–51).

Biotic Communities

The project area lies in the Desert Scrub/Grasslands biotic community. This plant community is dominated by two cold-temperature conifers, juniper and piñon. Habitats tend to be rocky with adjacent areas being grassland with parkland and savanna-like mosaics. The understory consists of grasses and shrubs that include threadleaf groundsel, snakeweed, galleta grass, Indian ricegrass, western wheatgrass, dropseeds, and junegrass. Shrubs include rabbitbrush, winterfat, and sagebrush. Other plants not uncommon include cliffrose, Apache plume, Mormon-tea, fourwing saltbush, and soapweed (Brown 1994:52–55).

The Desert Scrub/Grasslands has several distinctive mammalian species that follow the vegetation communities of this biome. These taxa include pinyon mouse and the bushy-tailed woodrat (Brown 1994:52–55). Less common taxa include ground squirrel, kangaroo mouse, and vole. The coyote and black-tailed jackrabbit are found throughout the province. Large ungulates are poorly represented, with mule deer and elk being the most common. The pronghorn occurs as an incursionary species from adjacent or former grasslands.

Several avian species are characteristic of the Desert Scrub/Grasslands. These include the pinyon jay, gray flycatcher, and black-throated gray warbler (Brown 1994:56). Other taxa in the region include the plateau whiptail lizard, rattlesnake, and bobcat.

Paleoenvironment

It is estimated from adjacent dendroclimatological station data that there were eleven periods, each lasting more than one decade, from A.D. 700 to 1330 during which the mean tree-ring width values are more than 1.1 standard deviation units above the mean. These eleven periods include the decades A.D. 720 to 730, 780 to 800, 880 to 890, 910 to 920, 1010 to 1020, 1050 to 1070, 1110 to 1120, 1190 to 1200, 1230 to 1240, 1260 to 1270, and 1300 to 1330. These periods represent exceptionally wet and cool climatic episodes. In climatic contrast, ten periods, each spanning one or more decades, of exceptionally hot and dry years occurred from A.D. 700 to 710, 740 to 760, 830 to 840, 990 to 1000, 1030 to 1040, 1080 to 1100, 1130 to 1150, 1170 to 1180, 1210 to 1220, and 1280 to 1290 (Eck 1994:55). These climatic episodes of alternating exceptionally hot and dry, and cool and wet, events would have directly affected human use of the project area.

CULTURE HISTORY OVERVIEW

Paleoindian Period (11,000 to 6000 B.C.)

Paleoindian peoples are defined as early Holocene hunters and foragers who were the first to inhabit the North American continent. Originally believed to be dependent on now extinct megafauna such as bison, mammoth, and mastodon, recent research has shown that Paleoindian groups also utilized varied floral and faunal resources (Cordell 1997). Material remains include a toolkit consisting of lanceolate projectile points, end and side scrapers, knives, gravers, chisel gravers, drills, spokeshaves, and utility flakes (Judge 1973:327). Regional settlement is believed to have been seasonal although some reoccupation of campsites may have occurred. Kelley and Todd (1988) make a point that given the new migrants unfamiliarity with newly encountered floral and faunal species, the Paleoindians would have tended to concentrate on proven sources of food, i.e., migratory game animals such as mammoth and bison. Paleoindian mobility is, therefore, explained by the necessity to follow wide-ranging herd animals. Paleoindian sites are often found on promontories near water sources and are generally within the seasonal range of herbivorous animals (Judge 1973:330).

The various Paleoindian cultures represented in the region include Clovis (9500–9000 B.C.), Folsom (8800–8300 B.C.), and Plano Complexes (7000–6000 B.C.) (Irwin-Williams and Haynes 1970). In the San Juan basin there is thought to be a lapse in human occupation between 8000 and 6600 B.C., possibly as a result in a decrease of effective moisture during this period (Stuart and Gauthier 1981:29; Vivian 1990:81). Also, Paleoindians likely occupied upland areas (elevations from 2,128 to 3,040 m [7,000 to 10,000 ft]) in the region (Stuart and Gauthier 1981:29). The Paleoindian toolkit includes lanceolate projectile points/knives, end and side scrapers, knives, gravers, chisel gravers, drills, spokeshaves, and utility flakes (Judge 1973). There is a growing diversification in tool kits throughout the period, possibly explained by the extinction of megafauna later in the period and the tendency for groups to settle into territories and focus on local resources in a more restricted area (Stone 1999).

Archaic Period (6000 to 400 B.C.)

The Archaic period is characterized by continuation of the hunting and foraging economy of the preceding Paleoindian period with technological adaptations to changing climatic conditions. Around 6000 B.C. the North American climate changed to a much warmer and drier Altithermal pattern, causing widespread faunal and floral changes (Cordell 1997). Most megafauna became extinct and smaller modern species became predominant. Human populations adapted to these changes and material culture became diversified. A distinction is made between northern Archaic groups, referred to as the Oshara Tradition (Irwin-Williams 1973), and more southerly groups, referred to as the Cochise Tradition (Sayles and Antevs 1941). The Oshara Tradition includes five phases: Jay (5500–4800 B.C.), Bajada (4800–3300 B.C.), San Jose (3300–1800 B.C.), Armijo (1800–800 B.C.) and En Medio (800 B.C.–A.D. 400). This typological division is somewhat arbitrary as projectile point types from both traditions frequently overlap. Both groups employ smaller point styles with shouldered hafting elements occurring sometime around 3200 B.C.

A growing reliance on plant foods during the Archaic period is also evidenced by grinding tools such as one-handed manos and basin metates. Settlement patterns are diverse with no ecological determinants except that Archaic populations tended to camp near areas of high floral and faunal diversity. Later in the period, ca. 1800 B.C., maize was introduced. In some areas maize is quickly adopted and becomes a staple, in others it is less important compared to wild plant resources and is not habitually grown until the Basketmaker III period (Dello-Russo 1999).

The first evidence of definable architecture appears during the middle-to-late Archaic period (1800 B.C.–A.D. 600). Pitstructures, archaeologically defined by shallow oval enclosures surrounded by postholes and often associated with fire-cracked rock, appear to have been used for short term or seasonal habitation near abundant resource locations. This adaptation is scattered widely across the San Juan Basin. Habitation and resource areas tend to be located near permanent water sources and on upland dune ridges and mesa-canyon associations. Populations tended to depend on collecting wild plant foods such as grass seeds, piñon nuts, juniper berries, hackberry, amaranth, and cacti (Vivian 1990:99–105).

Basketmaker II–III Period (400 B.C. to A.D. 720)

The beginning of the Basketmaker period (Basketmaker II 400 B.C. to A.D. 500) is characterized by hunters/gatherers engaging in horticulture, while later in the period (Basketmaker III A.D. 500–720) storing excess foodstuffs beyond their seasonal needs. Instead of a mobile lifeway based on natural resource abundance, these people begin a longer seasonal habitation and possibly even permanent habitation in areas that are both productive for maize-based agriculture and seasonal hunting (Stuart and Gauthier 1981:36). The timing of this shift in subsistence strategy seems to vary widely across the southwest, and Stuart and Gauthier note that these changes are probably "fragile, sporadic and determined by local population density". They further note that this period is highly variable in terms of settlement pattern and site size and that surface surveys may miss Archaic period remains that lie beneath later occupations. The few consistent patterns during this period are the location of sites near permanent water sources and their proximity to mountainous areas (Stuart and Gauthier 1981:409).

Later habitation sites increase in size indicating population aggregation into villages generally in upland settings that average 1,976 m (6,500 ft) in elevation (Stuart and Gauthier 1981). Some authors argue that some peoples retained the hunting and gathering lifeway and that these groups essentially lived among sedentary groups (Stuart and Gauthier 1981). Pottery was developed at about A.D. 300 (Vivian 1990:99) and a significant reduction in the size of projectile point forms indicates the use of the bow and arrow.

Pueblo I Period (A.D. 720 to 920)

The Pueblo I period is characterized by linear and crescent-shaped surface storage and living structures in association with pitstructures. During this period there was a decrease in effective moisture with an increasing oscillation in precipitation from year to year. Most aggregated settlements were dependent on maize-based agriculture supplemented by seasonal hunting and wild seed gathering. Wild plant foods were probably still very important in years when precipitation would not permit excess agricultural production to last throughout the winter.

In the Chaco Canyon area, the initial construction of "Great Houses" begins during the Pueblo I period (Vivian 1990). Previously undecorated pottery assumed new decorated forms that included mineral-based paints and neck-banding on plain vessels (Dello-Russo 1992:43). Larger settlements continued to be occupied in upland settings (Stuart and Gauthier 1981). In some areas populations were more mobile with a segment of the population leaving seasonally and returning for the winter and/or summer months (Schmader 1994).

Pueblo II Period (A.D. 920 to 1120)

The Pueblo II period is defined by the building of small, linear, above ground habitation structures or roomblocks while retaining the pitstructure form as an auxiliary habitation or religious structure (kiva). Initially, there is a trend in aggregated settlements to be at higher elevations in riverine settings. By A.D. 1000, in nearly all areas of New Mexico, there is a reversal in this trend. There is an abandonment of higher elevation areas in favor of lower elevation basin settings (Stuart and Gauthier 1981). Pottery types such as Red Mesa and Gallup Black-on-white are characteristic of the period.

In the central San Juan Basin, local adaptations are referred to as the Early Bonito phase—A.D. 920 to 1020—and the Classic Bonito phase—A.D. 1020 to 1120. These phases indicate a shift in architecture and settlement patterns. The development of Chacoan communities begins, marked by the construction of planned, multi-storied "Great Houses" and large "Great Kivas". There is also a continuation of small house sites with linear pueblos associated with subterranean kivas (Vivian 1990:203–206). The population is estimated to have increased throughout the period and six-fold in the Chuska River Valley (Gillespe and Powers 1983). Subsistence resource shortfalls may have become more common and maize-based farming became more intensive with water control and conservation features becoming more common (Vivian 1990:214). An extensive road system was built that extended in a general radial pattern from Chaco Canyon to the margins of the San Juan Basin (Nials et al. 1983). Tainter and Gillio (1980) relate the rapid growth of population during the period in the San Mateo Valley that coincides with a period of increased and stable moisture. Pueblo II sites increase in density from approximately 4.8 per square mile early in the period, to 15.6 in the middle and 28.4 in the latter stages. During the middle to late Pueblo II period Chacoan influence in the San Mateo area produced three outlier sites El Rito, San Mateo, and Kin Nizhoni. Recent survey data in the project area indicates Pueblo II period occupation (Burleson and Phippen 2003).

Pueblo III Period (A.D. 1120 to 1320)

The Pueblo III period was one of great change in the southwest. The San Juan Basin saw community development in its peripheries such as at Mesa Verde, Cibola, and Acoma. The Chaco core area fluoresces and then collapses with a general abandonment by the late 1170s. There is a reoccupation of Chaco Canyon by Mesa Verde peoples during the 1175 to 1250 period based on the sudden appearance of Mesa Verde style pottery and new pueblo construction as well as older pueblo reconstruction. In the San Mateo Valley Tainter and Gillio (1980) portray a sudden drop in population during the Hosta Butte Phase. The very high site density of the Late Pueblo II period dropped to 5.2 per square mile after the first 50 years of the period. A brief reoccupation occurred at approximately A.D. 1250 in the El Rito outlier area. Ceramics during this period relate to Mesa Verde influence in the Chaco outlier system.

The Rio Grande districts saw an increase in population. Aggregation of peoples in the eastern pueblos resulted in larger planned communities (50+ rooms). This probably resulted from a combination of immigration and local population growth (Crown et al. 1996). In addition to population growth there is a shift in settlements away from river terraces and floodplains to elevated upland settings. There was a corresponding shift to dry land agricultural techniques. New pottery decoration techniques were adopted using vegetal-based paints to create the nearly ubiquitous Santa Fe Black-on-white type.

Pueblo IV Period (A.D. 1320 to 1540)

The Pueblo IV period is considered one of cultural florescence in the Rio Grande region (Wendorf and Reed 1955). The tendency of aggregation into fewer and larger pueblos continued, and sites with

1000+ rooms are common in the Santa Fe (Galisteo), Chama, and Pajarito districts. These large settlements tend to be in riverine and valley bottom settings, lower in elevation than aggregated settlements during the preceding Pueblo III period. Outlying small fieldhouse sites were also built near varied resource areas (Snead 1995). It is during the Pueblo IV period that the population is considered to have reached its maximum levels, and material culture attained its most sophisticated level. Glaze-painted pottery becomes predominant and is roughly contemporaneous with Katsina cult iconography that indicates a new religion had spread into the region from the south (Adams 1991). Pueblo IV sites in western NM are associated with ancestral villages of Acoma and Zuni. These are located some distance from the project area.

Another development during this time is the migration of Athapaskan (Dineh and Apache) peoples from the north. The arrival date of the Athapaskans into northwest New Mexico is debated by scholars (Kelley 1982). Spanish colonists in the mid-sixteenth century referred to local Athapaskan peoples as "Apaches", and those living west of the Rio Grande as "Apaches de Navajo" (Brugge 1984). Exactly when the Navajo became distinct from other Apaches is not known. The subsistence pattern of the early Navajo was probably based on horticulture combined with hunting and gathering. Early Spanish records indicate the Navajo were farming by the early 1600s (McNitt 1972; Wozniak 1988), but whether they adopted horticulture from local Puebloan peoples or prior to their arrival in the Dinetah is unclear (Bailey and Bailey 1986). Betancourt (1980) uses the presence or absence of horticulture as the basis for distinction between the Navajo and other Athapaskan (Apache) peoples.

Historic Period (A.D. 1540 to Present)

The first Spanish colonial capital was established at the Tewa community of Yunge Oweenge in 1598. This changed Puebloan culture radically in economic, religious, social, and political terms. Endemic disease; raiding by Navajo, Ute, Apache, and Comanche peoples; and the Spanish system of land grants and mission establishment also took their toll. They drastically reduced traditionally held areas and population. The first European presence in the Grants and Bluewater areas was during the late sixteenth to mid-seventeenth centuries with Spanish exploratory and military expeditions. The early Spanish community of San Rafael is an example of an early Spanish colonial occupation with its mission and settlement. The arrival of the Spanish created tension between the indigenous peoples and Europeans.

In 1599 the Spanish, under the command of Viceroy Don Juan de Oñate, conducted punitive military action against Ácoma Pueblo, killing some 500 residents and imprisoning, enslaving, and maiming others. This action was in response to attacks on Spanish military scouting parties transgressing on Pueblo lands. The Pueblo Revolt of 1680 was a reaction to Spanish authority and the revolt did remove, temporarily, Spanish rule. In 1692, however, Spain with an army under De Vargas reasserted its claim on northern New Mexico and held it until 1821 when Mexico won its independence. Mexico held claim to what is now New Mexico until 1846 when the U.S. Army, under S. W. Kearny, took possession of the territory during the U.S. and Mexico War. Throughout this period...

> ...The landscape produced a dispersed pattern of settlement consisting of numerous small enclaves of population and culture. These Pueblo and Hispano villages became bastions of cultural preservation, for they were at once so self-sufficient that they had little need for the outside world and yet so poor that the outside world had little need for them. In isolation they persisted for centuries, changing little [DeBuys 1985].

The San Juan Basin remained Navajo territory throughout the early historic period while the Ute claimed the territory generally north of the San Juan River. The economy of the area was dominated by sheep herding and small-scale agriculture. In 1863, the U. S. army forced an initial 8,000 Navajos to relocate to the Mescalero Apache reservation at Bosque Redondo in east central New Mexico (McNitt 1972). This action was a punitive reaction to raids by Navajos in the area and on the community of Santa Fe in 1860. A punitive military expedition mounted by Kit Carson in the San Juan Basin resulted in scorched earth policies and the persuasion of Navajo leaders Barboncito and Delgado to gather their followers and relocate to Bosque Redondo. More militant leaders, such as Manuelito, maintained guerilla warfare against the New Mexico militia and their Ute, Zuni, and Hopi allies. At Bosque Redondo, the relocated Navajos faced starvation and extremely poor living conditions that resulted in more than 2000 who died of disease and starvation. The Navajo returned to the San Juan Basin in 1868 under the guidelines of the Treaty of 1868 that was negotiated in Washington, D.C. by Federal officials and the Navajo leaders. In the 1870s a United States Army facility was established along the eastern flank of the San Juan Basin (Williams 1986:112). The facility was established to discourage periodic Navajo raiding of Puerco and Chama River Euroamerican settlements.

Euroamerican settlements that include Grants, Coolidge, and Thoreau were established during the late nineteenth century. Their settlement coincided with the construction of the Atlantic and Pacific railroad. The railroad made farming and ranching profitable. Mining and lumber milling developed in response to cheaper shipping by railroad. The railroad stimulated economic development in the Grants and Bluewater areas.

PREVIOUS ARCHAEOLOGICAL WORK

Prior to conducting the Class III pedestrian field survey, a site records search of the Archaeological Records Management Section (ARMS) in Santa Fe identified 46 previously recorded sites within 1.6 km (1 mi) of the proposed project areas. These sites are summarized in Table 1.

Table 1. Recorded sites within 1.6 km (1 mi) of the project area.

Site LA #	Cultural Affiliation	Type	Eligibility for NRHP
18190	Anasazi	Structural	Eligible
18193	Anasazi	Structural	Eligible
18194	Anasazi	Structural	Eligible
18195	Anasazi	Structural	Eligible
18196	Anasazi	Structural	Eligible
18197	Anasazi	Structural	Eligible
18198	Anasazi	Structural	Eligible
18199	Anasazi	Structural	Eligible
18200	Anasazi	Structural	Eligible
18201	Anasazi	Structural	Eligible
18202	Anasazi	Structural	Eligible
18209	Anasazi	Structural	Eligible
18210	Anasazi	Structural	Eligible
18211	Anasazi	Structural	Eligible
18212	Anasazi	Structural	Eligible
18214	Anasazi	Structural	Eligible
18215	Anasazi	Structural	Eligible
32684	Anasazi	Structural	Eligible
32685	Anasazi	Structural	Eligible
32686	Anasazi	Structural	Eligible

Site LA #	Cultural Affiliation	Type	Eligibility for NRHP
32688	Anasazi	Structural	Eligible
32689	Anasazi	Structural	Eligible
35102	Anasazi	Structural	Eligible
50359	Anasazi	Structural	Eligible
50360	Anasazi	Structural	Eligible
50361	Anasazi	Structural	Eligible
50362	Anasazi	Structural	Eligible
50367	Anasazi	Structural	Eligible
50368	Anasazi	Structural	Eligible
50369	Anasazi	Structural	Eligible
50370	Anasazi	Structural	Eligible
50371	Anasazi	Structural	Eligible
50374	Anasazi	Not listed	Not listed
50375	Anasazi	Not listed	Not listed
50376	Anasazi	Structural	Eligible
50377	Anasazi	Structural	Eligible
50378	Anasazi	Structural	Eligible
50379	Anasazi	Structural	Eligible
50380	Anasazi	Structural	Eligible
60606	Anasazi	Structural	Eligible
82633	Anasazi	Not listed	Not listed
82634	Anasazi	Not listed	Not listed
82635	Anasazi	Not listed	Not listed
140033	Anasazi	Nonstructural	Eligible
140034	Historic	Structural	Eligible
140035	Anasazi	Structural	Eligible

FIELD METHODS

Cultural Resources

The term "cultural resources" refers to any historic or prehistoric resource. The term "historic property" specifically refers to a cultural resource that has been determined eligible for inclusion to the National Register of Historic Places (NRHP). These terms imply a great deal more than prehistoric and historic material remains, ruins, or standing structures. They encompass a wide range of material remains that have the potential to provide information about the occupation of the project area. These terms also refer to any records related to such a resource or property. A total of five classes of historic properties (districts, buildings, structures, sites, and objects) are defined as eligible for listing on the NRHP (36 CFR 60.3). Usually, historic properties are classified within more than one of these categories.

Archaeological Categories

- **Archaeological Site**
  A site is a concentration of cultural remains inferred to be the location of specific human activities.

- **Archaeological Features**
  A feature is defined as nonportable cultural remains including but not limited to hearths, storage pits, firepits, architecture, or undisturbed layers of deposited material.
- **Artifact**
  Artifacts are portable cultural remains that exhibit evidence of human use or alteration.
- **Culturally Altered Landscape**
  A culturally altered landscape is a landscape modified by human activity, including but not limited to roadways, agricultural fields, farming terraces, and irrigation ditches or other water control devices.
- **Component**
  A site component is defined by the New Mexico State Historic Preservation Division as a generally continuous site occupation with a single cultural affiliation.
- **Historical Site**
  An historic site is a location, building, or neighborhood more than 50 years old.

Archival Research

A review of the previous archaeological and/or historical work carried out in the vicinity of the project area was completed. This review included the records at the New Mexico Cultural Resources Information System (NMCRIS) maintained by the Archaeological Resource Management Section (ARMS).

Field Survey

A 100 percent pedestrian survey (Class III) of the project area was conducted on August 31, 2004. Nonoverlapping transects spaced at no greater than 15 m (50 ft) were used to traverse the project terrain. Cultural resources were recorded as a site using the following criteria: (1) ten or more artifacts of two or more artifact classes or types within a 400 m^2 area; or, (2) the presence of a structure, feature, or midden. Resources not meeting these criteria, in a severely disturbed, highly mobile context, or isolated features with poor data potential were recorded as isolated occurrences (IOs).

Sites were to be marked by driving a 46 centimeter (cm) (18 inch [in])-long metal rebar into the ground. The rebars have an aluminum cap stamped with an EMI field number. All cultural resources were to be documented using standard procedures and forms. No artifacts were collected. Archaeological site and isolated occurrence locational information was collected using a GPS Garmin *e-Trex* Vista that has an accuracy of ± 3 m (10 ft). No sites were identified.

Sparse and low lying vegetation across the project area allowed for an estimated 75 percent ground visibility. Three previously unrecorded archaeological sites and five IOs were identified. Richard Burleson served as principal investigator and field director.

SURVEY RESULTS

No previously recorded or unrecorded cultural resource sites and eight isolated occurrences were identified during the Class III survey.

ISOLATED OCCURRENCES

Eight isolated occurrences (IOs) were recorded during the survey. Table 2 summarizes the eight IOs. EMI considers the field recordation of the IOs as having exhausted their information potential and, therefore, they require no further work. None of the IOs are deemed eligible for listing on the National Register of Historic Places or State Register of Cultural Properties. Their locations are shown in Figure 10.

Table 2. Isolated occurrences summaries.

IO	Description	UTM Location; Zone 13
1	Sandstone slab metate fragment	244990 E; 3919794 N
2	Highly weathered sandstone mano fragment	245173 E; 3919825 N
3	Nine corrugated whiteware sherds	245020 E; 3919981 N
4	Two unidentified Cibola whiteware sherds	244964 E; 3919942 N
5	Highly weathered sandstone mano fragment	244849 E; 3919703 N
6	Three Puerco Black-on-white sherds	244727 E; 3919739 N
7	Three Chaco Black-on-white sherds	244777 E; 3919969 N
8	One corrugated whiteware sherd	244725 E; 3919966 N

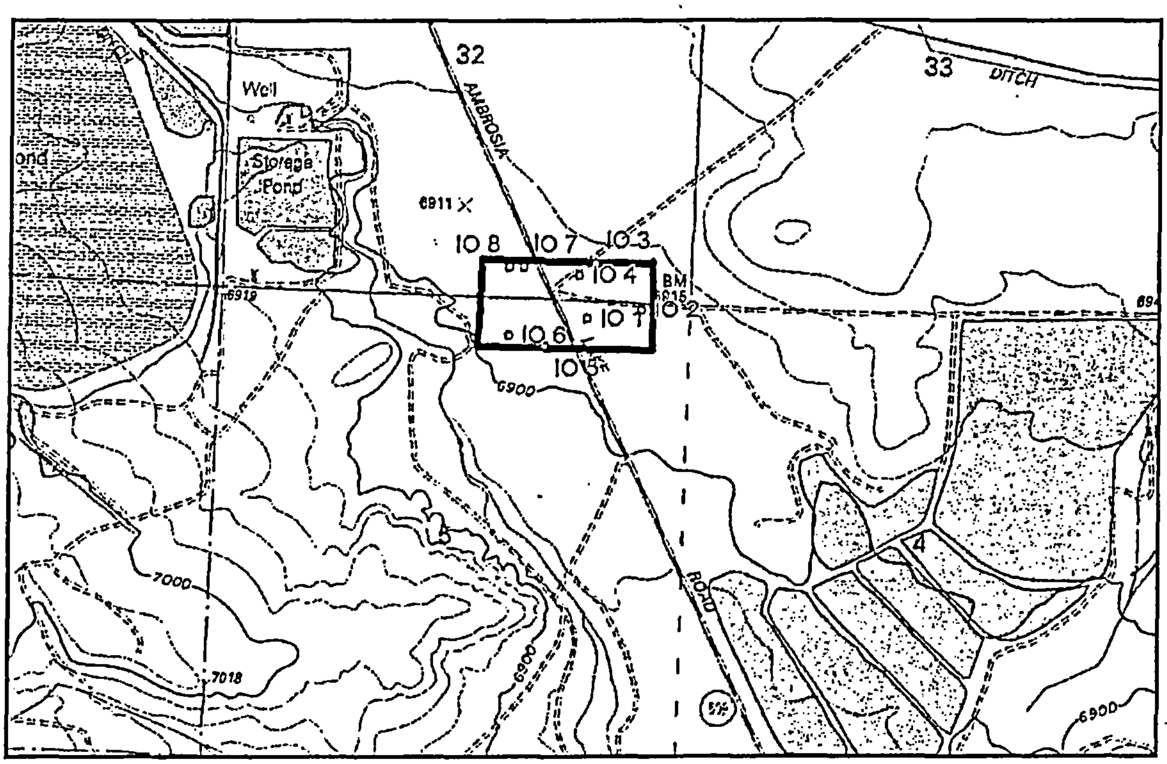

Figure 3. Isolated occurrences.

SUMMARY

A total of eight isolated occurrences were identified during the Class III cultural resources inventory. All of the isolated occurrences relate to the Late Pueblo II period from A.D. 1075 to A.D 1150. This assessment is based on the presence of Chaco Black-on-white and Chaco McElmo Black-on-white ceramics identified within the project area. The project area is situated on a flat, between areas of higher topographic relief that contain Pueblo II period residential sites. The isolated occurrences identified during this survey are likely material remains from those sites located just east and west of the current project area.

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"Richard Burleson"
<RichardB@emi-nm.c
om>

09/21/2004 08:56 AM

To: <PLuthiger@ramc.net>
cc:
Subject: RE: Study Report,

Peter,
The report should be sufficient for the NMDOT. However, there are no cultural materials within the existing highway right-of-way. EMI recommends that no further cultural resource investigations are necessary at this time for the proposed project undertaking. If there are any further questions or concerns, please do not hesitate to contact me. If the NMDOT has any further questions or concerns, feel free to direct any technical discussion concerning the archaeological survey to me. Thanks

-----Original Message-----
From: PLuthiger@ramc.net [mailto:PLuthiger@ramc.net]
Sent: Tuesday, September 21, 2004 6:30 AM
To: Richard Burleson
Subject: Study Report,

Richard,
Just received the report that you prepared.
I also forwarded the invoice for payment.

Reviewing the report appears to reflect the lack of any significant resources in the study area, which was good to hear. Based on the map of
the locations of the occurrences, there does not appear to be any presnt within the highway right of way. We are planning on submitting this to the
NMDOT as part of a project we are working on with them.
Could you to provide an amendment to the report that I can attach to the
complete document that states there were no occurrences within the right of
way.
You can either email or fax this.
Thanks
Peter

Biological Survey Memorandum
for the
KGL Haul Road Project
Milan, McKinley County, New Mexico

Prepared by Marron and Associates, Inc.
November 3, 2004

INTRODUCTION

KGL Associates, Inc. is planning to construct a two lane, 2.5-mile long haul road to transport uranium mine tailings from a tailings pile located on the north side of NM 509 adjacent to the Section 4 Ponds to an existing disposal site on the south side of NM 509 near Ponds 1 and 2. The haul road will be constructed on the same alignment as the existing dirt road between the two sites, and will be upgraded and widened to support large dump trucks. The haul road project also includes construction of an overpass of NM 509 at Milepost 3.4. The haul road will be in operation to move tailings for 18 to 24 months. The overpass will be removed when the hauling operation is completed.

BIOLOGICAL SURVEY

Two biologists from Marron and Associates, Inc. conducted a biological survey for the project area on October 28, 2004. The survey included four transects 2.5 miles long and 200 feet wide. The survey identified any biological resources that may be impacted by the haul road project, including general vegetation, wildlife, migratory birds, wetlands, noxious weeds, and protected plant and wildlife species. References and databases containing information on biological resources in the project area were reviewed beforehand, including lists of federal and state protected species and the New Mexico Noxious Weed List.

Vegetation

The project area is located within lower Juniper Savannah vegetation type on the west side of the project area and grades into Plains-Mesa Grassland on the east side. The dominant plants in the project area include blue grama grass (*Bouteloua gracilis*), winterfat (*Krascheninnikovia lanata*), rabbitbrush (*Ericamaria nauseosa*), Southwestern rabbitbrush (*Chrysothamnus pulchellus*), dropseed (*Sporobolus contractus*), sand sagebrush (*Artemisia filifolia*), blazingstar (*Mentzelia* sp.), one-seed juniper (*Juniperus monosperma*), spineless horsebrush (*Tetradymia canescens*), and snakeweed (*Gutierrezia sarothrae*). Other common plants in the project area include common sunflower (*Helianthus annuus*), Russian thistle (*Salsola tragus*), milkweed (*Asclepias latifolia*), hoary aster (*Machaeranthera canescens*), nightshade (*Solanum elaeagnifolium*), kochia (*Kochia scoparia*), ring muhly (*Muhlenbergia torreyi*), gumweed (*Grindelia nuda*), ragwort (*Senecio flaccidus*), and four-wing saltbush (*Atriplex canescens*). A small man-made wetland in the project area was dominated by saltcedar (*Tamarix chinensis*) and cattail (*Typha latifolia*). There were no unusual or rare plant communities within the project area. A complete list of plants observed in the project area is provided in Appendix A.

Wetlands

There is a single wetland on the north segment of the existing dirt road. The wetland is several hundred yards long and extends upstream and downstream of the road culvert. This wetland was man-made and resulted by installing a 30 x 4 x 4-foot, box-like wooden structure across the arroyo. This structure covers and insulates a water pipeline that crosses the arroyo. This wetland was created by water extracted from wells and being backed up on each side of this barrier. Man-made wetlands are not under the jurisdiction of the U. S. Army Corps of Engineers 404 permit system.

Noxious Weeds

There were no New Mexico Class A, or B noxious weeds present. Saltcedar was the only Class C noxious weed in the project area and was located near the wetland.

Wildlife

Several wildlife species potentially reside in the project area. The majority of the mammals and reptiles in the area are permanent residents in the area and have limited mobility. Many of the birds are seasonal residents, migrating in and out of the area in the spring and fall, respectively. The birds expected in the project area may include northern mockingbird (*Mimus polyglottos*), mourning dove (*Zenaida macroura*), turkey vulture (*Carthartes aura*), western kingbird (*Tyrannus verticalis*), barn swallow (*Hirundo rustica*), common raven (*Corvus corax*), and scaled quail (*Callipepla squamata*). Other vertebrate species that may be found in the area include elk (*Cervus Canadensis*), pocket gopher (*Thomomys* sp.) desert cottontail (*Sylvilagus audubonі*), black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), coyote (*Canis latrans*), New Mexico whiptail (*Cnemidophorus neomexicanus*), collared lizard (*Crotaphytus collaris*), gopher snake (*Pituophis meanoleucus*), and striped whipsnake (*Masticophis taeniatus*).

Mammals detected in the project area included desert cottontail, black-tailed jackrabbit, ground squirrel (*Spermophilus* sp.), pocket gopher, kangaroo rat (*Dipodomys ordi*), elk, mule deer, badger (*Taxidea taxus*), and bobcat (*Lynx rufus*).

Birds observed during the biological survey include common raven, turkey vulture, sparrow (*Zonotrichia* sp.), white-crowned sparrow (*Zonotrichia leucophrys*), dark-eyed junco (*Junco hyemalis*), and horned lark (*Eremophilia alpestris*). The scattered juniper trees near the existing tailings pile on the north end of the project area provide potential nesting and perching habitat for the ferruginous hawk (*Buteo regalis*). A species considered to be sensitive by some land management agencies. This bird species was not present, and no juniper trees will be removed for the project.

The haul road construction will disturb a few acres of wildlife habitat, and may affect the habitat of a few birds, small mammals, and reptiles. The project will have a very small effect on the available wildlife habitat, because the haul road will be constructed on the footprint of an existing dirt road. A few acres of marginal wildlife habitat will be removed by widening the existing dirt road.

Endangered, Threatened, and Species of Concern

Bird species, such as, peregrine falcon (*Falco peregrinus anatum / Falco peregrinus tundrius*) and bald eagle (*Haliaaeetus leucocephalus*) may fly over the project area. The project area is unsuitable for the bald eagle and many other birds, because there are very few shrubs and no trees of sufficient height for perching and nesting of these species. In addition, there are no cliffs in the project area, which are the preferred habitat of the peregine falcon. There is suitable grassland habitat in the general area outside the project area for mountain plover (*Charadrius montanus*). No mountain plovers were observed in the project area and grassland within the right-of-way is too tall for plover habitat. The project area does not contain suitable habitat (coniferous woodland) for the Mexican spotted owl (*Strix occidentalis lucida*), and northern goshawk (*Accipiter gentilis*). Although gray vireo (*Vireo vicinior*) could occur just west of the project area, there was no suitable habitat for this species within the project area. The only riparian habitat in the project area is within the wetland. This riparian habitat lacked any overstory structure and is unsuitable for the southwestern willow flycatcher (*Empidomax traiilii extimus*), yellow-billed cuckoo (*Coccyzus americanus*), and black tern (*Chlidonas niger*), because it lacks a tree overstory and shrub understory. The wetland has many cattails along the edges of the arroyo. Western burrowing owl (*Athene cunicularia*) and black-tailed prairie dog (*Cynomys ludovicianus*) were searched for, but not found. Several ground squirrel colonies are in or near the haul road alignment. The burrows within these colonies are potential habitat for burrowing owls. No federal or state listed wildlife species were detected in the project area, and project activities will not affect any listed species.

Plants with agency status that occur in McKinley County include Gooding's onion (*Allium goodingii*), Acoma fleabane (*Erigeron acomanus*), Sivinsky's fleabane (*Erigeron sivinskii*), Parish's alkali grass (*Puccinellia parishii*), and Zuni fleabane (*Erigeron rhizomatus*). Parish's alkali grass occurs in wetland, but the wetland in the project area lacked the alkali-crusted soils that this species prefers. There is no suitable habitat within the project area for the remainder of these plants.

CONCLUSIONS

The proposed 2.5-mile haul road will disturb a few acres of wildlife habitat due to widening the existing dirt road. A single wetland was observed on the north end of the project area. This wetland is man-made and a Section 404 permit will not be required. Saltcedar was the only Class C noxious weed found in the project area. The biological survey did not detect any federal- or state-listed wildlife or plants within the project area. Overall, the project will have minimal effects to vegetation, wildlife, and the environment.

APPENDIX A

VASCULAR PLANT SPECIES OBSERVED IN THE KGL HAUL ROAD PROJECT AREA

ASCLEPIADACEAE (Milkweed Family)
Helianthus latifolia (Milkweed)

ASTERACEAE (Sunflower Family)
Ambrosia acanthicarpa Hook. (Flatspine bursage)
Artemisia filifolia Torr. (Sand sagebrush)
Artemisia ludoviciana Nutt. (Louisiana sage)
Chrysothamnus pulchellus (Gray) Greene (Southwestern rabbitbrush)
Ericameria nauseosa (Pallas ex Pursh) Nesom & Baird (Rubber rabbitbrush)
Grindelia nuda Wood var. aphanactis (Rydb.) Nesom (Gumweed)
Gutierrezia sarothrae (Pursh) Britt. & Rusby (Broom snakeweed)
Helianthus annuus (Common sunflower)
Hymenopappus sp. (Hymenopappus)
Machaeranthera canescens (Pursh) Gray (Hoary aster)
Senecio flaccidus Less. var. *flaccidus* (Threadleaf groundsel)
Tetradymia canescens DC. (Spineless horsebrush)
Townsendia exscapa (Richards.) Porter (Stemless townsendia)
Xanthium strumarium L. (Cocklebur)

BORAGINACEAE (Borage Family)
Cryptantha crassisepala (Torr. & Gray) Greene (Deertongue)

BRASSICACEAE (Mustard Family)
Descurainia obtusa (Greene) O.E. Schulz (Blunt tansy mustard)

CACTACEAE (Cactus Family)
Escobaria vivipara (Nutt.) Buxbaum (Pincushion cactus)
Opuntia phaeacantha Engelm. (Tulip prickly pear)
Opuntia polyacantha Haw. (Plains prickly pear)

CHENOPODIACEAE (Goosefoot Family)
Atriplex canescens (Pursh) Nutt. (Fourwing saltbush)
Atriplex patula ssp. *hastata* (L.) H.&C. (Halberd-leafed saltbush)
Kochia scoparia (L.) Schrad. (Summer cypress)
Krascheninnikovia lanata (Pursh) A.D.J. Meeuse & Smit (Winterfat)
Salsola tragus L. (Prickly Russian thistle)

CUPRESSACEAE (Juniper Family)
Juniperus monosperma (Engelm.) Sarg. (One-seed juniper)

CYPERACEAE (Sedge Family)
Cyperus sp. (Flatsedge)
Schoenoplectus acutus (Muhl. ex Bigelow) A.& D. L^ve (Bulrush)

EUPHORBIACEAE (Spurge Family)
Chamaesyce serpyllifolia (Pers.) Small ssp. *serpyllifolia* (Thymeleaf sandmat)

FABACEAE (Bean Family)
Astragalus mollissimus Torr. (Wooly milkvetch)

JUNCACEAE (Rush Family)
Juncus balticus Willd. (Baltic rush)

LINACEAE (Flax Family)
Linum australe Heller (Southern flax)

LOASACEAE (Loasa Family)
Mentzelia sp. (Blazingstar)

POACEAE (Grass Family)
Achnatherum hymenoides (Roemer & J.A. Schultes) Barkworth (Indian ricegrass))
Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths (Blue grama)
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi (Alkali muhly)
Muhlenbergia torreyi (Kunth) A.S. Hitchc. ex Bush (Ring muhly)
Muhlenbergia sp. (Muhly)
Pleuraphis jamesii Torr. (Galleta grass)
Sporobolus contractus A.S. Hitchc. (Spike dropseed)

POLYGONACEAE (Milkwort Family)
Eriogonum corymbosum Benth. (Wild buckwheat)

SOLANACEAE
Solanum elaeagnifolium (Nightshade)

TAMARICACEAE
Tamarix chinensis Lour. (Saltcedar)

TYPHACEAE (Cattail Family)
Typha latifolia L. (Cattail)

APPENDIX B

FEDERAL ENDANGERED, THREATENED, CANDIDATE, AND SPECIES OF CONCERN THAT MAY OCCUR IN THE KGL HAUL ROAD PROJECT AREA

Rev: August 2004

FEDERAL ENDANGERED, THREATENED,
PROPOSED, AND CANDIDATE SPECIES
AND SPECIES OF CONCERN WITHIN COUNTIES IN NEW MEXICO
November 15, 2004

McKinley County

ENDANGERED

Black-footed ferret (*Mustela nigripes*)**
Southwestern willow flycatcher (*Empidonax traillii extimus*)

THREATENED

Bald eagle (*Haliaeetus leucocephalus*)
Mexican spotted owl (*Strix occidentalis lucida*) with critical habitat
Zuni fleabane (*Erigeron rhizomatus*)

CANDIDATE

Yellow-billed cuckoo (*Coccyzus americanus*)
Zuni bluehead sucker (*Catostomus discobolus*)

SPECIES OF CONCERN

American peregrine falcon (*Falco peregrinus anatum*)
Arctic peregrine falcon (*Falco peregrinus tundrius*)
Black tern (*Chlidonias niger*)
Northern goshawk (*Accipiter gentilis*)
Mountain plover (*Charadrius montanus*)
Western burrowing owl (*Athene cunicularia hypugea*)
New Mexico silverspot butterfly (*Speyeria nokomis nitocris*)
San Juan checkerspot butterfly (*Euphydryas anicia chuskae*)
Acoma fleabane (*Erigeron acomanus*)
Goodding's onion (*Allium gooddingii*)
Parish's alkali grass (*Puccinellia parishii*)
Sivinski's fleabane (*Erigeron sivinskii*)

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Endangered	=	Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened	=	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Candidate	=	Candidate Species (taxa for which the Service has sufficient information to propose that they be added to list of endangered and threatened species, but the listing action has been precluded by other higher priority listing activities).
Species of Concern	=	Taxa for which further biological research and field study are needed to resolve their conservation status OR are considered sensitive, rare, or declining on lists maintained by Natural Heritage Programs, State wildlife agencies, other Federal agencies, or professional/academic scientific societies. Species of Concern are included for planning purposes only.
**	=	Survey should be conducted if project involves impacts to prairie dog towns or complexes of 200-acres or more for the Gunnison's prairie dog (*Cynomys gunnisoni*) and/or 80-acres or more for any subspecies of Black-tailed prairie dog (*Cynomys ludovicianus*). A complex consists of two or more neighboring prairie dog towns within 4.3 miles (7 kilometers) of each other.

APPENDIX C

NEW MEXICO ENDANGERED AND THREATENED SPECIES THAT MAY OCCUR IN THE KGL HAUL ROAD PROJECT AREA

New Mexico Game & Fish - Animals in BISON-M

County = 'NM-McKinley'
Status = 'State NM: Endangered'
Current Date: November 1, 2004

Category: Birds
Flycatcher, Willow, SW. *Empidonax traillii extimus*

Category: Fish
Sucker, Bluehead, Zuni *Catostomus discobolus yarrowi*

Status = 'State NM: Threatened'

Category: Birds

Eagle, Bald	*Haliaeetus leucocephalus*
Falcon, Peregrine, American	*Falco peregrinus anatum*
Falcon, Peregrine, Arctic	*Falco peregrinus tundrius*
Vireo, Gray	*Vireo vicinior*

The New Mexico Natural Heritage Program is part of the Natural Heritage Network and the Museum of Southwestern Biology, Department of Biology at the University of New Mexico
Last Updated May 13, 2004

PERMIT REVISION 99-1 TO PERMIT NO. MK009RE
OLD STOPE LEACHING
EXISTING MINING OPERATION

MINING AND MINERALS DIVISION
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

Permit Revision 99-1 to Permit MK009RE is issued by the Director of the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department to:

Quivira Mining Company
6305 Waterford Boulevard, Suite 325
Oklahoma City, OK 73118

(Permittee) for the Old Stope Leaching operation, located in McKinley County, New Mexico.

This permit revision incorporates the closeout plan for the Old Stope Leaching operation into Permit No. MK009RE. The following sections of Permit No. MK009RE are added or revised to read as follows:

Section 1. SCOPE OF PERMIT

This permit includes Old Stope Leaching and the Section 35 Mine, both operated by Quivira Mining Company, in one permit, Permit No. MK009RE, hereinafter called Old Stope Leaching. Permit No. MK002RE, approved on July 24, 1995 for the Section 35 Mine, is incorporated into Permit No. MK009RE in its entirety.

Section 2. STATUTES AND REGULATIONS

This Permit is issued pursuant to the New Mexico Mining Act, NMSA 1978, §69-36-1, et seq. (1993).

This Permit is subject to all applicable requirements of the New Mexico Mining Act (Act), New Mexico Mining Act Rules (Rules), Subparts 1-14, and any other regulations which are now or hereafter in force under the Act; and all such regulations are made a part of this Permit by this reference.

Section 3. PERMIT APPLICATION PACKAGE

The Permit Application Package (PAP) is comprised of the following documents:

A. Old Stope Leaching Permit Application, submitted May 27, 1997

B. Section 35 Permit Application, submitted December 29, 1994

C. Section 35 Site Assessment, submitted June 30, 1994

D. Old Stope Leaching Operations Maps, submitted May 13, 1998

E. September 1, 1998 letter from Permittee to MMD regarding rights of way

The Permit Revision Package (PRP) is comprised of the following documents:

A. Old Stope Leaching Closeout Plan, submitted May 23,1997, final revision August, 30, 1999.

B. Section 35 Closeout Plan, submitted December 29, 1995, revised and incorporated into the revised Old Stope Leaching Closeout Plan.

<u>Section 4.</u> <u>PERMIT AREA AND DESIGN LIMITS</u>

A. The permit area encompasses portions of the following areas: Sections 13, 15, 22, 23, 24, 25 and 26 of T14N R10W and Sections 17, 18, 19, 20, 29, 30, 32, 33, 34 and 35 of T14N R9W, in McKinley County, New Mexico (NMPM). The approved permit area is delineated in the PAP in Appendix D of the Old Stope Leaching Permit Application entitled *Old Stope Leaching Proposed Permit Area.* Those portions of the permit area that constitute rights of way in Sections 32 and 34 are described in a letter from the Permittee to MMD dated September 1, 1998.

B. Design limits are described in the PAP in Appendix G of the Old Stope Leaching Permit Application entitled *Old Stope Leaching - Proposed Design Limit.* The following units, shown in Figures 5 and X-1 of the Section 35 Mine permit application, are approved as existing units for conventional mining operations in Section 35 and are subject to the reclamation standard of §507.A of the Rules, absent a waiver under §507.B:

1. Plant Site (buildings, head frame, shaft)

2. Ore/Waste Rock Storage Pad

3. Dewatering Ponds

4. Roads

For Old Stope Leaching operations, expansion or addition of injection holes, pipelines, equipment sheds, pump stations or roads within the approved design limits for the purpose of old stope leaching, up to a maximum of 50 acres of disturbance of previously undisturbed land as indicated on the Old Stope Leaching Operations Maps submitted May 13, 1998, will not require a permit modification or revision if it does not change the closeout plan. Expansion or addition of injection holes, pipelines, equipment sheds, pump stations or roads within the approved design limits for the purpose of old stope leaching beyond a total of 50 acres of disturbance of previously undisturbed land as indicated on the Old Stope Leaching Operations Maps submitted May 13, 1998, or beyond the approved design limits will require a permit modification or revision and will be subject to the new unit standards specified in §507.C. The Permittee will submit an update annually to MMD describing all additional disturbance for the previous year. The update will include a map showing all disturbance at the time of permit approval, as indicated on the Old Stope Leaching Operations Maps submitted May 13, 1998, and highlight all subsequent disturbance.

Section 5. **FINDINGS OF FACT**

A. The Permit application contains all the information required, as required by §503.F.1.

B. The Permittee has provided written information stating the name and official business address of the Permittee and its agent for service, as required by §503.F.2 of the Rules.

C. The Permittee has provided the required signature and certification, as required by §503.F.3 of the Rules.

D. Permit application fees have been paid in the amount of $4,748.50 for Old Stope Leaching and in the amount of $1,500.00 for the Section 35 Mine, as required by §503.F.4 of the Rules.

E. Public notice for the permit application was given on November 6, 1997 for Old Stope Leaching and on February 17, 1995 for the Section 35 Mine, as required by Subpart 9 and §503.F.5 of the Rules. There were no requests for a public hearing.

F. Public notice for the closeout plan was given, as required by Subpart 9, and §506.J.1 of the Rules.

G. The Permittee has paid the closeout plan permit revision fee of $4,500, as required by §506.J.2.

H. The Permittee has provided satisfactory financial assurance to complete the closeout plan in the amount of $577,616 as required by §506.J.2 of the Rules. The financial assurance instrument is in the form of a Third Party Guarantee.

I. The approved post-mining land use for the permit area is grazing. The closeout plan demonstrates that the work to be done will reclaim disturbed areas within the permit area to a condition that allows for the re-establishment of a self-sustaining ecosystem, following closure, appropriate for the life zone of the surrounding areas.

J. The Secretary of Environment has provided a written determination stating that the Permittee has demonstrated that the activities to be permitted or authorized will be expected to achieve compliance with all applicable air, water quality and other environmental standards if carried out as described in the closeout plan, as required by §506.J.5 of the Rules.

K. The Permittee has submitted a notarized statement signed by the Permittee that he agrees to comply with the performance and reclamation standards and requirements of the permit, Subpart 5 and the Act and allows the Director to enter the permit area without delay for the purpose of conducting inspections during mining and reclamation, as required by §503.F.6 and §506.J.6 of the Rules.

L. The permit for Old Stope Leaching incorporates prior reclamation sites in Sections 17, 22, 24 and 33. These sites are considered disturbed land and are not included as new disturbances according to Section 4B of this Permit.

M. All leachfields shall be reclaimed by removing all pumping equipment, plugging and abandoning injection holes as described in the closeout plan and by revegetating the surface disturbance around each hole and pipeline as described in the closeout plan.

N. The permittee shall remove all buildings from the permit area. Concrete foundations that would extend above final grade shall be broken up and disposed of on site. Headframes and shaft facilities shall be dismantled and removed.

O. The Permittee shall close out all surface ventilation holes. Surface ventilation equipment shall be dismantled and either removed or disposed of on site. Vent holes shall be plugged by removing exposed steel casing, welding a steel plate on the open hole and then placing a steel reinforced concrete plug on the sealed hole. The plug will then be backfilled with a minimum of two feet of alluvial fill.

P. The Permittee shall close out all shafts. All surface ancillary items shall be removed and disposed of. Exposed shaft components shall be removed and a steel plate welded on the open hole. A steel reinforced concrete plug, which exceeds the inside diameter of the shaft by several feet, shall be placed on the sealed shaft. The area surrounding the shaft will then be backfilled and covered with a minimum of two feet of alluvial fill.

Q. The Permittee shall remove all above-ground pipelines and associated equipment utilized in the Old Stope Leaching process. Excavations associated with underground pipelines will be backfilled to blend in with surrounding terrain.

R. The Permittee shall revegetate disturbed areas within the permit area using the seed mix described in the closeout plan. Compacted areas, such as roads or parking areas, shall be disced to a depth of at least 1.5 feet prior to seeding.

S. The Permittee shall use properly constructed and maintained check dams, water bars, terracing along the contour, installation of armored channels, slope reduction and/or use of other erosion control practices where required for the successful establishment of vegetation.

Section 6. COMPLIANCE REQUIREMENTS

The Permittee shall comply with the statutes and regulations in Section 1 and with the applicable regulatory and permitting requirements. The issuance of this permit does not relieve the Permittee from the responsibility of complying with other state and federal requirements and standards.

Section 7. AGENCY RIGHT OF ENTRY

The Permittee shall allow the authorized representatives of the Director without advance notice or a search warrant, upon presentation of appropriate credentials, and without delay to:

A. enter as provided for in §503.F.6, and §1101.E.1 of the Rules; and

B. be accompanied by one or more citizens for the purpose of conducting an inspection in accordance with §1210.B of the Rules when the inspection is in response to a complete financial assurance release application.

Section 8. PERMIT COVERAGE

This permit shall be binding on any person or persons conducting mining or reclamation operations under this Permit.

Section 9. COMPLIANCE WITH THE PERMIT

The Permittee shall conduct mining and reclamation operations only as described in the approved PAP, PRP, the permit and any revisions or modifications approved by the Director. The Permittee shall comply with any and all conditions that are incorporated into the PAP and PRP.

Section 10. GENERAL OBLIGATIONS AND CONDITIONS

Each permit issued by the Director is subject to the following conditions:

A. The Permittee may be subject to enforcement action according to Subpart 11 of the Rules for failing to conduct reclamation and closeout operations as described in the closeout plan or for failing to submit any of the following:

   1. annual reports as required by §509 of the Rules;

   2. annual fees as required by §202 of the Rules;

B. The Permittee shall submit an application for permit revision for standby status pursuant to §505 and Subpart 7 of the Rules if : (1) cessation of mining operations exceeds 180 days after approval of the closeout plan and (2) the Permittee desires to suspend reclamation pursuant to the closeout plan.

C. If the Permittee conducts exploration within the permit area, the following criteria must be met, unless otherwise provided in the closeout plan. First, all roads and drill sites will be constructed to the minimum size to safely access and conduct exploration activities. Second, all areas affected by exploration activities, including roads and drill sites, will be seeded and water bars and other sediment control structures will be constructed to control sediment loss until areas are established with stabilizing vegetation. If the Permittee conducts exploration within the permit area which exceeds 5 acres, financial assurance shall be provided for exploration associated disturbances. During each inspection by MMD, the Permittee shall identify to the inspector any areas of new disturbance due to exploration activities made since the previous inspection. The Permittee shall also identify any areas of new disturbance due to exploration activities in each annual report submitted to MMD.

D. The Permittee shall conduct vegetation monitoring of the reclaimed areas using standard and accepted practices and methodologies once reclamation activities have been completed. Vegetation monitoring shall be performed at least two times in years 3 through 7 after reclamation activities have been completed and at least two times in years 8 through 12. Sampling for release shall follow the procedures described in the closeout plan. The Permittee shall submit an interim sampling plan for approval by MMD by June 1, 2000.

E. Any areas within the Old Stope Leaching permit area that are disturbed to provide borrow material for reclamation shall be reclaimed using the same techniques described in the closeout plan.

F. Rio Algom Limited's financial soundness shall be monitored and reported quarterly by a contractor selected by the State during the time a third party guarantee is used for financial assurance. The costs of the monitoring shall be paid by the Permitee. If the financial soundness of Rio Algom Limited at any time no longer qualifies as a third party guarantor, the Permittee shall obtain acceptable replacement financial assurance or conduct closeout measures in accordance with §1208.D.9 of the Rules.

G. The Permittee shall notify MMD at least 15 days prior to performing reclamation activities.

H. Prior reclamation site Section 19 shall be resampled for perennial plant cover by August 31, 2000. The Permittee shall arrange for the sampling. The sampling must be conducted by an experienced range scientist. MMD shall be given a minimum of two weeks notification prior to sampling. The sampling methods shall be approved in advance by MMD. If Section 19 does not meet the cover standard, it shall be incorporated into the Old Stope Leaching permit.

I. The 12 year periods of financial assurance liability, as per §1204.A of the Rules, for Sections 17, 22, 24 and 33 (and Section 19, if applicable) shall begin at the end of June, 1994 when reclamation, with the exception of vegetation establishment, was completed for these sites.

<u>Section 11.</u> <u>CONCLUSIONS OF LAW</u>

A. The Director has jurisdiction over the Permittee and the subject matter of this proceeding.

B. The PAP is complete, accurate and complies with the requirements of the New Mexico Mining Act (the Act) and §502 and §503 of the Rules.

C. The PRP is complete, accurate and complies with the requirements for closeout plans of the Act and §505, §506 and §507.A of the Rules.

D. The Permittee, Quivira Mining Company, is permitted to conduct mining and reclamation operations at the Old Stope Leaching Operation in McKinley County, New Mexico, upon the condition that the Permittee complies with the requirements of the Order, the Act, the Permit Conditions and requirements imposed by this decision.

I certify that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals responsible for obtaining the information, I believe the submitted information is true, accurate, and complete.

I certify that I have read, understand and will comply with the requirements of this Permit Revision. I also agree to comply with the performance and reclamation standards and requirements of the permit, the Rules, and the Act, and allow the Director to enter the permit area without delay for the purpose of conducting inspections.

Authorized Representative of the Permittee

Executive Vice President
Title

Quivira Mining Company
Company

Subscribed and sworn to before me this 3rd day of December, 1999

Kay Oh. Walker
Notary Public

My Commission Expires

January 27, 2001

ORDER

NOW THEREFORE, IT IS HEREBY ORDERED that Permit Revision 99-1 of the Old Stope Leaching Permit, incorporating the closeout plan and allowing Quivira Mining Co. to conduct closeout and reclamation operations in McKinley County, New Mexico, is approved.

By Order of the Director, Mining and Minerals Division, Energy, Minerals and Natural Resources Department, of the State of New Mexico.

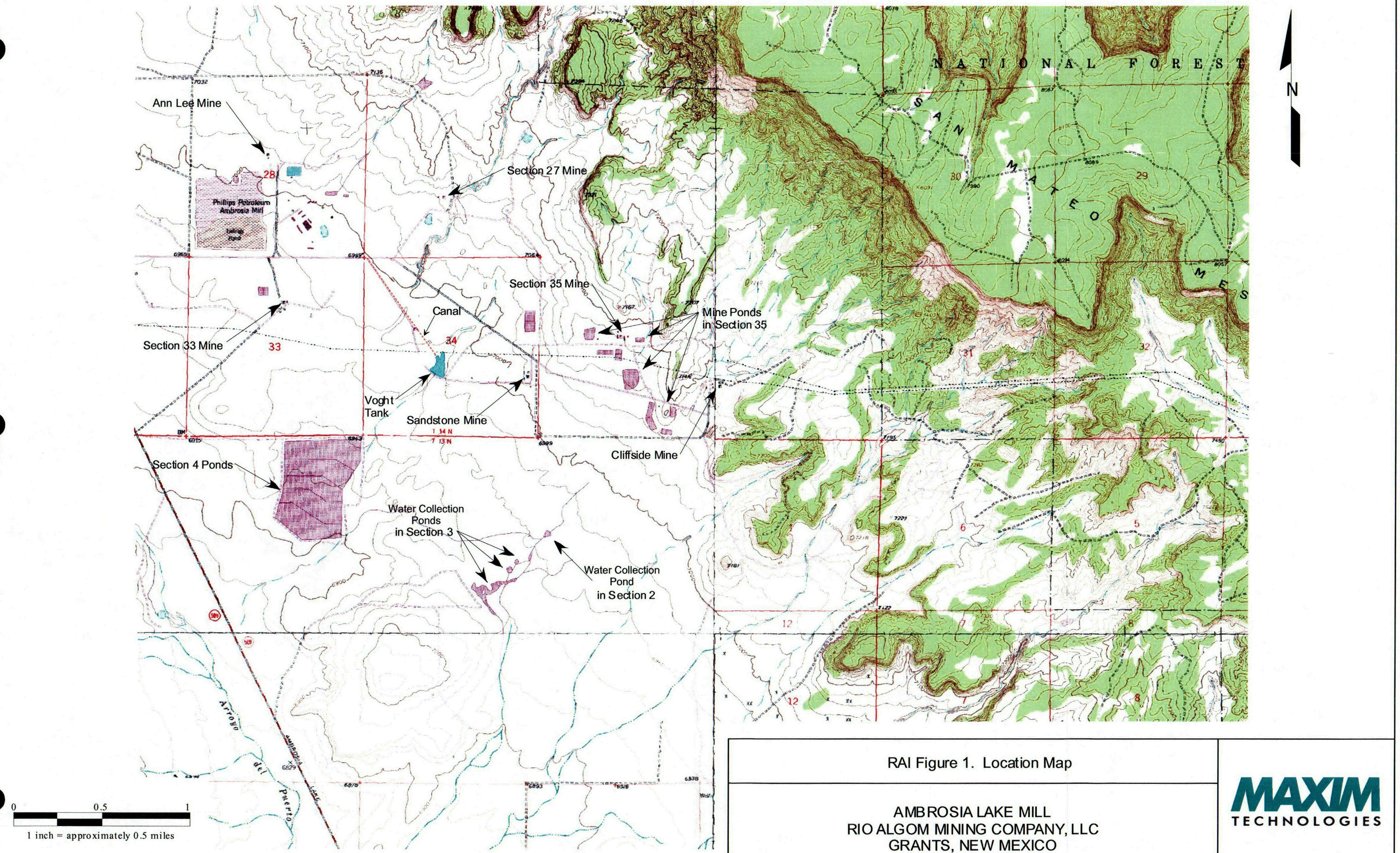
Mining and Minerals Division

The State of New Mexico

By: DMBl

Douglas M. Bland, Director
Mining and Minerals Division
Energy, Minerals and Natural
Resources Department

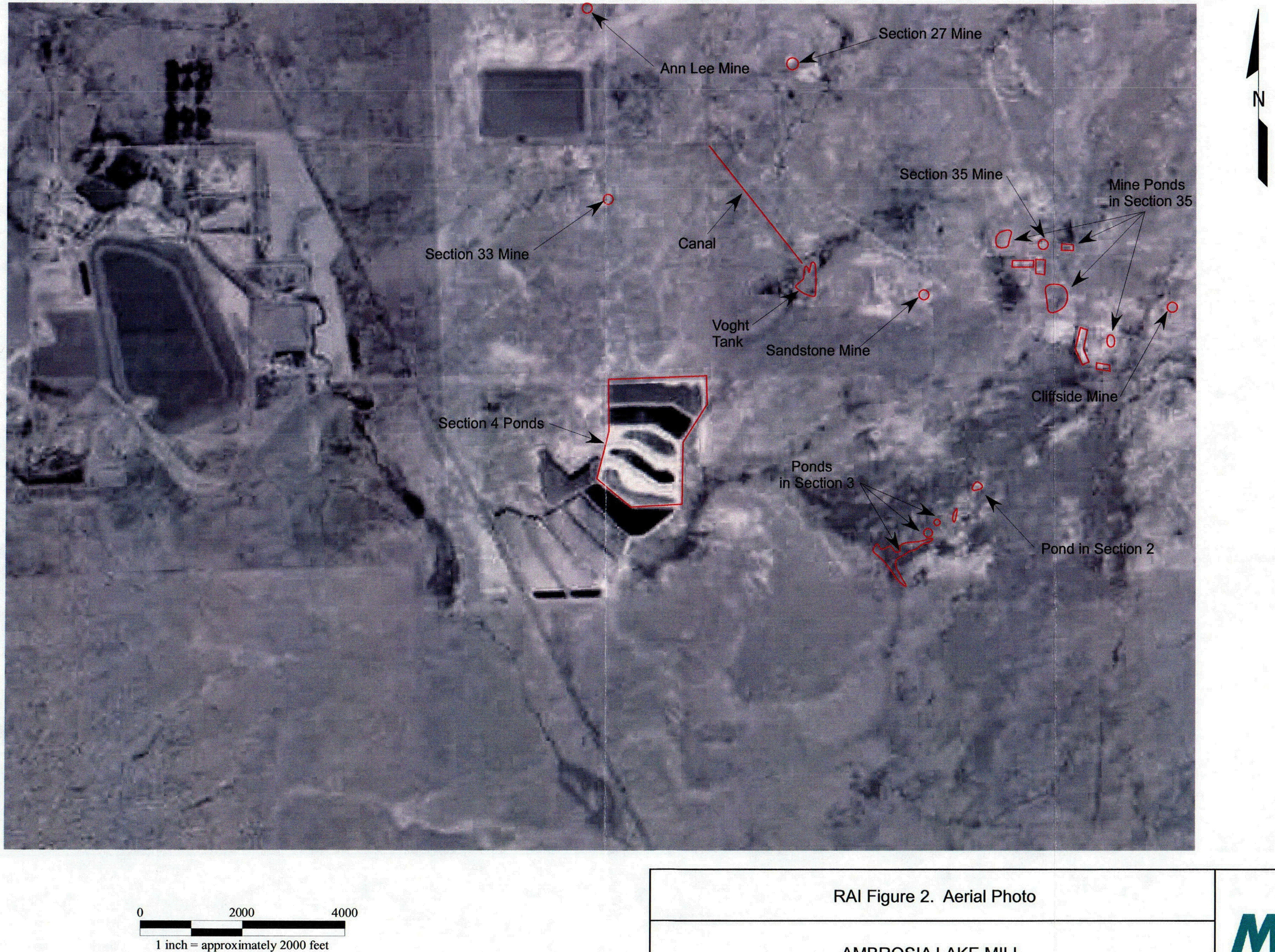
DATED: 12/10/99



RAI Figure 1. Location Map

AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

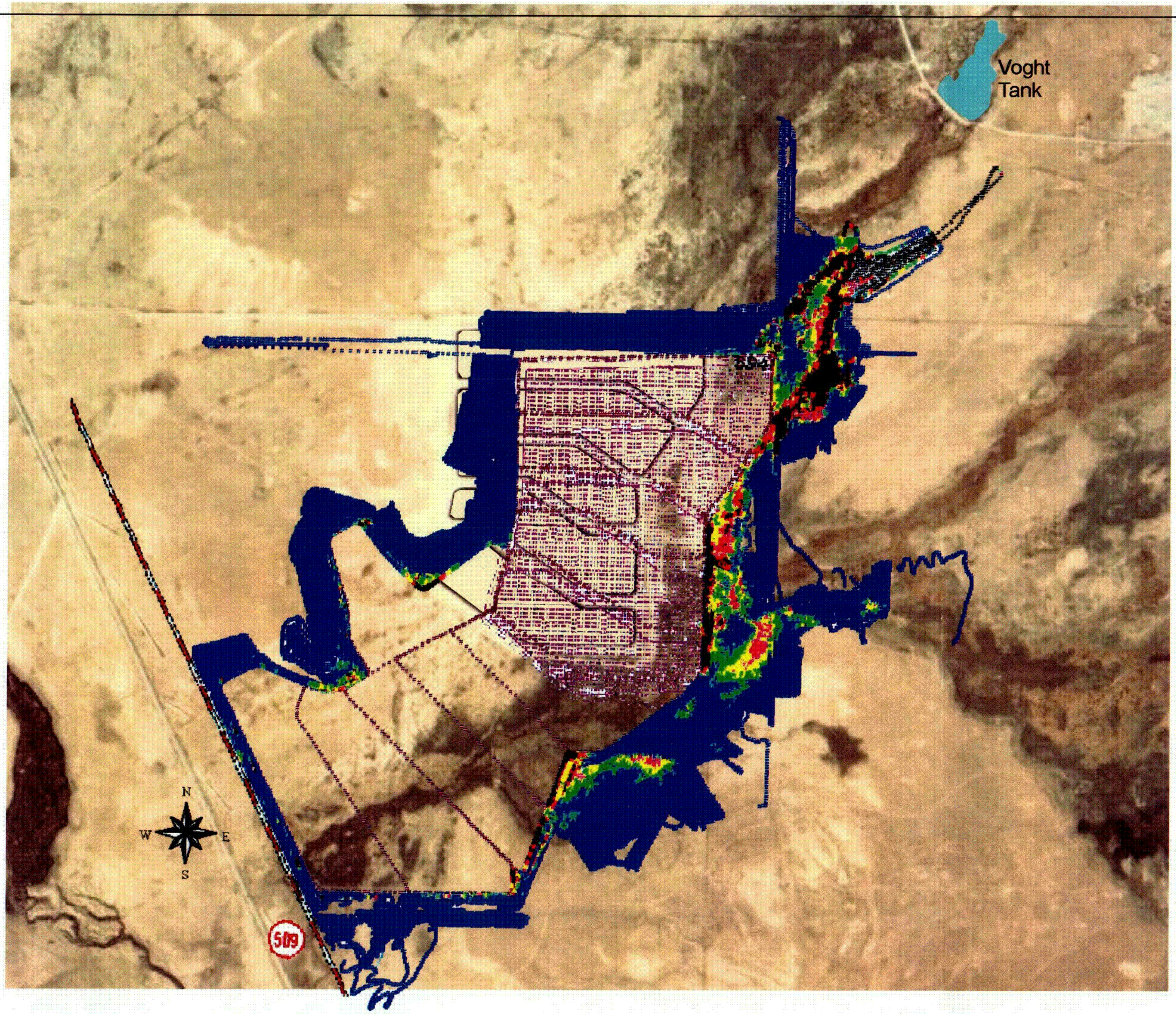
MAXIM TECHNOLOGIES



RAI Figure 2. Aerial Photo

AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES



Blue	0 - 30,000 counts per minute
Green	30,001 - 35,000 counts per minute
Yellow	35,001 - 40,000 counts per minute
Red	40,001 - 50,000 counts per minute
Black	+ 50,001 counts per minute

0 0.5 1

Miles

RAI Figure 3. Gamma Radiation Survey Results

AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

RELOCATION PLAN FOR LINED EVAPORATION PONDS

NRC License #SUA-1473

Docket #40-8905

RIO ALGOM MINING LLC AMBROSIA LAKE, NEW MEXICO

Prepared for:

Rio Algom Mining LLC.

by: Maxim Technologies, Inc.

v 0.1

JANUARY 2005

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1.0 INTRODUCTION

1.1. PURPOSE

This plan addresses the methods and procedures to be implemented to ensure that the consolidation and transport of evaporation pond materials and any associated soils impacted by milling related byproduct materials from the Section 4 Ponds and Pond 9 is performed in a manner that is protective of the health and safety of employees, the public and the environment. Materials associated with the Section 4 Ponds and Pond 9 are classified as byproduct material as defined by the Atomic Energy Act of 1954, as amended.

Final verification of successful reclamation of the lined pond areas will utilize those methods and procedures contained within the Soil Decommissioning Plan submitted to NRC on January 19, 2005. Description of the final disposal and stabilization of the materials associated with Pond 9 and the Section 4 evaporation ponds within Pond 2 will be transmitted as a separate design document for review and approval by NRC.

<u>SCOPE</u>

This document contains descriptions of the consolidation and transport of byproduct material and materials impacted by licensed activities within Rio Algom Mining LLC's lined evaporation ponds. The information within this plan is presented in the following sections:

- Section 1 - Introduction, provides the purpose, scope, and the general site information of the lined evaporation ponds;

- Section 2 – Environmental Conditions, describes the regional and site geographical, meteorological, geotechnical, hydrological, and pre-pond construction information pertinent to the area and associated with the lined evaporation ponds;

- Section 3 – Operational Conditions, describes the operational history, construction, and pond system management of lined evaporation ponds;

- Section 4 – Surface Reclamation Plan, describes the proposed surface relocation of the Section 4 ponds and Pond 9, providing the approach and rationale for the proposed activities;

- Section 5 – Health, Safety, and Environmental Protection, describes methods to be implemented to ensure that all activities are evaluated and performed in a responsible manner to ensure protection of employees and workers, the public, and the environment;

- Section 6 – Cost, presents the third-party contractor costs to implement the surface reclamation project.

1.2. GENERAL SETTING

The lined evaporation ponds, which were part of the Rio Algom uranium milling operations, are located in the Ambrosia Lake Mining District in the southeastern part of McKinley County, New Mexico, locus of two uranium processing mills and approximately 30 – 40 underground uranium mines. The Section 4 evaporation ponds are located entirely within Section 4, Township 13 North, Range 9 West; hence, they're described as the "Section 4" evaporation ponds. Pond 9 is immediately east of the former Pond 1 and 3 impoundments at the Rio Algom mill site. The location of the evaporation ponds is presented in Figure 1-1.

The Section 4 ponds are sequentially numbered from #11 through #21 and are located approximately two (2) miles east of Rio Algom's conventional mill facility primarily located on Section 31, Township 14 North, Range 9 West. These lined ponds were originally used to contain excess process solutions associated with the milling operations of conventionally mined ores at the Ambrosia Lake mill site and later to contain fluids from the facility's mine water treatment program and the facility's groundwater "Corrective Action Plan" (NRC, 1992).

2.0 ENVIRONMENTAL SETTING

This section describes the environmental setting of the Section 4 Ponds. Detailed information on the environmental setting surrounding Pond 9 can be found in the *Application for Alternate Concentration Limits in the Alluvial Materials at the Quivira Mill Facility Ambrosia Lake, New Mexico* (ACL) (Rio Algom, 2001).

2.1. REGIONAL SETTING

Roughly 22 miles long and six to ten miles wide, Ambrosia Lake Valley is more than 7,000 feet above mean sea level (Figure 1-1). The northwest-southeast strike of the valley is the result of a regional northwest dip of sandstone and shale units comprising the southern margin of the San Juan Basin. Valley bottom alluvial fill overlies erodable shale of the Mancos Formation, while more resistant sandstones form ridges on either side of the valley. Topography in the valley bottom is limited to low relief, alluvial/colluvial slopes cut by incised ephemeral stream channels.

2.1.1. Climate

Like the rest of The San Juan Basin, Ambrosia Lake is an arid to semiarid region where evaporation typically exceeds precipitation by a factor of five or more. Summertime temperatures have been known to be as high as 110 degrees Fahrenheit. Annual precipitation averages less than nine inches, while annual pan evaporation ranges from 46 inches to 72 inches per year (Stone et al., 1983). Precipitation typically occurs as brief, heavy rain showers during summer thunderstorms. These short, high volume events are characterized by abundant runoff and very little infiltration. For this reason, prior to mining activities, groundwater was present in those bedrock units beneath the valley floor that have outcrop exposure on surrounding highlands. The highlands are where the overwhelming majority of recharge occurs (Stone et al., 1983). There are no natural perennial or intermittent surface water sources within the valley. Climatologic data is presented in Appendix A.

2.1.2. Flora and Fauna

The majority of Ambrosia Lake Valley habitat is classified as Great Basin Grasslands. However, well-documented long-term degradation of this habitat in central and western New Mexico, caused by historically poor grazing practices, has reduced productivity and species diversity on a regional basis (Fletcher and Robbie, 2004). Studies conducted during NRC-approved closure of the U.S. Department of Energy UMTRCA Title I site (located one mile due north of the Section 4 evaporation ponds) cited five Federal or State threatened or endangered species whose ranges overlap with habitat surrounding Section 4 Ponds. However, none of these species has been identified as actually occurring in the region (see Appendix B).

Among species cited are the black-footed ferret, the peregrine falcon, and the bald eagle. The ferret has not been observed in the area, likely because they coexist with prairie dog colonies that are poorly supported by degraded grasslands. While it should be noted that these species have been removed from the Endangered Species List, raptors such as peregrine falcons and bald eagles are similarly dependant on small mammals as a food source and, although they may occur as an occasional migrant, they have not been observed to nest or winter in the area.

Another of the five species, the rhizome fleabane, occurs only in soils derived from the Chinle shale, which is not exposed in the Ambrosia Lake area. The last threatened or endangered species noted by DOE was the Pecos sunflower, which is associated with perennial streams and irrigation ditches. This type of habitat is non-existent in the Ambrosia Lake area.

2.1.3. Land Use

Ambrosia Lake mining district is rural and sparsely populated. The closest populated area is the community of San Mateo (100 residents) located approximately nine miles to the southeast of the Section 4 evaporation ponds. The largest incorporated city in the region is Grants, New Mexico (population of 8,806) located approximately 20 miles south of the site (U.S. Census Bureau, 2000). Ninety percent of land use in McKinley County and the Ambrosia Lake area is low-density animal grazing, averaging between five and six animals per square mile (U.S. Department of Energy, 1987). The Federal government manages approximately sixty percent of McKinley County. Figure 2-1 presents land ownership in the area surrounding the Section 4 evaporation ponds.

2.1.4. Scenic Uses

Scenic resources in the Ambrosia Lake area include mill tailings piles, mill complexes and mines. Larger mines in the area have been reclaimed or are in the final stages of reclamation. Several secondary mines (small operator owned/operated) have not been reclaimed. Both Rio Algom's Ambrosia Lake tailings impoundment and DOE's former Phillips mill and tailings facilities have been reclaimed. Rio Algom's mill facility was demolished in the winter of 2003.

Mill demolition and tailings reclamation return visual values to conditions similar to the open, sparsely vegetated semi-desert terrain that existed prior to mining. In the future, the sole land uses will be marginal livestock grazing activities and electrical utility substation operation. Primary views for travelers on New Mexico Highway 509 will be scrub vegetation and unobtrusive, reclaimed and rock armored mill tailings to the northwest of the evaporation ponds. Mount Taylor's 11,301-foot summit and forested slopes will continue to be a visual resource in the southeast. To the east, San Mateo Mesa will continue to provide views of juniper bushes and pinon trees.

2.1.5. Cultural and Historic Uses

Rio Algom is committed to communicating with the Tribes and Pueblos within the region, informing them of the proposed closure activities and requesting input and comments. Comments will be taken into consideration and, if warranted, revisions to the proposed work elements, will be undertaken.

This project will be performed primarily on private land that has been previously disturbed by human activity (access roads used for mining, ranching, mill reclamation), thus, little potential for new disturbances exists. Cultural resource surveys have been conducted in the vicinity of the Section 4 Pond area and have identified sparse evidence of cultural and historic artifacts. Isolated occurrences of ceramic pottery shards were observed along the proposed haul road that are likely material remains originating from additional sites located on topographic highs situated north of the proposed project area. Surveys conducted along the proposed haul road and highway crossing by Rio Algom and the New Mexico Department of Transportation concluded that negligible impacts to known cultural and historic properties would result. Copies of cultural resources surveys are provided in Appendix C.

2.1.6. Bedrock Geology

Bedrock geologic units underlying surficial alluvial materials include the Mancos Shale, the Dakota Sandstone, and the Brushy Basin and the Westwater Canyon members of the Morrison Formation. The Mancos Shale, generally considered to be an aquiclude, is approximately 250 feet thick in Ambrosia Lake Valley. The underlying Dakota Sandstone is approximately 75 feet thick and rests on Brushy Basin shale units. Stratigaphically below the Brushy Basin, the Westwater Canyon is a primary water-bearing unit in the region. All units dip approximately three degrees to the northeast.

Primary structural features affecting local geologic conditions were established during late Cretaceous (approximately 100 million years ago) to early Tertiary (58 million years ago) and there is little current potential for seismic activity. An NRC-funded re-evaluation of the seismic aspects of all Title II sites concluded that the Ambrosia Lake tailings impoundments could withstand the peak ground acceleration (PGA) for the area (U.S. Nuclear Regulatory Commission, 1997) and accordingly meet criterion 4(e) of Appendix A of 10 CFR Part 40, Code of Federal Regulations.

2.1.7. Effects of Mining

The Ambrosia Lake mining district consists of approximately 30 to 40 mines that are, or were owned and operated by a number of different companies. Underground mines trend northwest-southeast across the Ambrosia Lake Valley. The underground workings nearest Section 4 Ponds are located in Sections 33 and 34. The Westwater Canyon member is the principal uranium ore-bearing unit in the region. In order to mine underground, the Westwater Canyon Member was dewatered by pumping all groundwater out and discharging it to the surface. A regional cone of depression has formed within bedrock units as a result of mine dewatering. The bedrock formations above the Westwater Canyon have essentially been dewatered within this cone of depression.

2.2. LOCAL SETTING

The Section 4 lined evaporation ponds were located to take advantage of low topography in the broad bottom of an ephemeral drainage channel. The lined ponds were built on fined-grained alluvial material that was deposited in the relict of an older drainage system (paleochannel) incised into the northeast dipping Mancos. Three thin (15-25 feet), fine-grained, silty sandstone interbeds (Tres Hermanos A, B and C sandstones) occur locally within the Mancos in the vicinity. Surface exposures of the Tres Hermaos B form prominent knobs on either side of the paleochannel and a small northeast trending escarpment across the lower half of the Section 4 Ponds (Figure 2-2).

The upper few feet of Mancos shale underlying alluvial materials is weathered and gradational to alluvial soil. Deeper shale is unweathered and generally dry due to low effective porosity and low hydraulic conductivity associated with high clay content. The alluvium is up to 50 feet in depth over the axis of the paleochannel, but is shallow to nonexistent near the margins of the channel.

2.2.1. Alluvial Soils

Alluvial soils are composed predominantly of silty sands and sandy to silty clays. Petrologic analysis indicates that they contain abundant clay, quartz, and chalcedony in limonite and calcite cement (see Rio Algom, 2001). Quartz is present ranging from 40-50 percent with chalcedony typically present near 24 percent by volume. Limonite and calcite each typically exceed ten percent of the sample. Gypsum constitutes approximately one to two percent by volume with very fine-grained magnetite present in trace amounts. Presence of abundant iron oxyhydroxides (limonite) and calcite give these soils a high capacity to attenuate metals and radionuclides (i.e. remove these constituents from infiltrating water).

2.3. SURFACE WATER

During uranium mining, mines located in catchments upgradient of the Section 4 Ponds [for example, the Anne Lee, Sandstone, Cliffside, and Section 35 mines, (Figure 2-3), were dewatered and the groundwater from the Morrison Formation was pumped into adjacent drainage channels, resulting in surface flow through the Section 4 Ponds area.

2.3.1. Mine Discharge

In a 1983 New Mexico Bureau of Mines Publication, Stone, and others note "*A large quantity of freshwater is currently being pumped to keep the mines dewatered. The quantity will increase as more and deeper mines are constructed. Dewatering will, in turn, cause large declines in water wells completed in the Morrison Formation. Water pumped from mines often contains* *elevated levels of radiochemicals and toxic metals.*" Figure 2-4 is taken from Stone and others (1983) and shows water production by uranium mines in the Ambrosia Lake Area during the period 1955-1977. This figure indicates that well over a quarter of a million acre-feet of water was pumped from mines at Ambrosia Lake during that period.

Historically, mine discharge has not been regulated by the NRC and has been considered unrelated to licensed milling activities. However it does supply water to saturate alluvial sediments and increase constituent mass in the alluvial soil matrix. The quality of mine discharge water was dependent on site-specific mine conditions, and mining processes. However, mine water drawn from the ore zone likely contained the same chemical constituents that are found in seepage from mill tailings. Data on older discharge events is sparse, however one example comes from samples of mine water collected by United Nuclear Corporation, cited in Stone et al., (1983) listing the concentrations in Table 2-1.

Table 2-1. Concentrations Reported in Mine Water Collected by United Nuclear Corporation

Total Dissolved Solids (TDS)	1,029-1,061 mg/L
Radium-226	19.3-25.8 pCi/L
Gross Alpha	74-275 pCi/L
Uranium	740-1630 pCi/L

Another, more current example of mine discharge water quality occurs north of the RAM mill site, at the Section 30 Mine, where concentrations of uranium, molybdenum, and selenium typically exceed Alluvial Groundwater Protection Standards established by the NRC, adjacent to the mill site (Table 2-2). It is important to note that analyses of this water were performed after it had been treated for discharge under an EPA National Pollution Discharge Elimination System permit.

Table 2-2. Comparison of treated mine water discharge (B-3) with current Alluvial Groundwater Protection Standards

	B-3 Ave	B-3 Max	GPS (NRC)
Molybdenum (mg/L)	0.23	0.29	0.06
Nickel (mg/L)			0.06
Lead-210 (pCi/L)			4.9
Radium-226+228 (pCi/L)	2.84	12	5
Selenium (mg/L)	0.14	0.24	0.05
Sulfate (mg/L)	1325	1750	
TDS (mg/L)	2940	3710	
Thorium-230 (pCi/L)			3.1
Natural Uranium (mg/L)	1.44	2.6	0.06

B-3 = Sampling point on Arroyo del Puerto adjacent to QMC Internal NPDES Outfall 001A.
mg/L = milligrams per Liter.
pCi/L = picocuries per Liter.

Mine discharge that flowed across Section 4 occurred as relatively high volume flow near the point of release. As surface flow moved downstream it lost volume to infiltration and evaporation. Channels lined with vegetation that cannot be supported today are visible in aerial photos from the period (Figure 2-5). Note the dark colored vegetation lining channels through the Ponds area that are present in this 1977 aerial photo, taken before all the lined ponds in Section 4 were constructed. Note also that vegetation diminishes before this secondary drainage reaches the primary drainage channel (Arroyo del Puerto).

Diminishing support for vegetation with distance indicates that, in spite of the large volume of mine water that Stone and others (1983) documented as being discharged to the Ambrosia Lake alluvium in the area of the future Section 4 Ponds during the period between 1955 and 1977 and the obvious surface manifestation of that water seen in Figure 2-5, infiltration and evaporation in an arid climate have not allowed sustained surface flows to continue to the primary drainage. Thus, any water and its dissolved and suspended constituent load does not move past the ponds area, concentrating mass, including the constituents of concern in alluvial soils beneath the existing lined evaporation ponds. Discharges started as early as 1957 and continued through the early 1980's. Data exists to show that fully saturated conditions had developed by the mid- to late 1970's. Most pumping to the drainage through the lined ponds area ceased in the early 1980s in the wake of dropping uranium prices and vegetation that had developed during mine discharge began to die away. Current aerial photographs show that vegetation has diminished to desert conditions found throughout the rest of the valley (Figure 2-6), indicating that the water to support plants seen in Figure 2-5 is gone.

Both the ephemeral drainage through the ponds area and the paleochannel join the primary Ambrosia Lake Valley drainage approximately one half mile down gradient of Pond 20. This primary drainage (Arroyo del Puerto) trends north to south and is fed by other minor ephemeral drainages. Residual groundwater flow in Arroyo del Puerto is also the result of mine discharge water, the bulk of which enters the system upgradient of its junction with the channel that drains the lined ponds area.

2.3.1.1. Storage of Mine Related Constituents in Alluvial Soils

The attenuation capacity of the alluvial materials removes constituents from groundwater along its flow path, storing constituent mass near areas of surface infiltration and reducing constituent concentrations in any resulting groundwater. Evaporation increases constituent load in surface water causing increased concentrations of TDS and constituents of concern. During evaporation, mineral species reach their saturation limit and begin to precipitate. Precipitates occur initially as small particles that give the water a milky appearance.

At the same time, surface flows infiltrate into alluvial materials carrying constituent mass with them. Initial infiltration becomes unsaturated at some point allowing evaporation to become predominant, depositing constituent mass in the subsurface. Later infiltration brings new constituent mass with it and transports some earlier mass to deeper levels in the subsurface.

This process occurs until true groundwater flow is established (groundwater levels have declined drastically, and most Section 4 Ponds monitor wells have gone dry since upgradient mine dewatering ceased in the mid 1980's). A separation of constituents of concern occurs during the infiltration/evaporation process; constituents that are highly adsorbed (for example, radium and thorium) remain near the surface and constituents that move more freely (for example, chloride, and to a lesser extent, uranium) are transported to deeper levels in the soil column. Both end member attenuation–transport processes cause constituent mass to accumulate in the subsurface.

2.3.1.2. Upgradient Soil Data Collection

The following summary is presented to support RAMs contention that impacts resulting from historic mine dewatering activities have influenced the land area where the Section 4 ponds were eventually constructed.

Preliminary soil sampling and radiation surveys performed in the vicinity of the Section 4 Ponds within the surface drainages provide evidence that mining impacts are present within the Section 4 Pond area. These preliminary characterizations demonstrate that the highest gamma readings are clustered in drainage bottoms between Voght Tank and the upgradient edge of the Section 4 Ponds. Other areas with high gamma readings delineate surface water channels from the east that can be clearly traced back to the mining features as seen in Figure 2-7.

Results of preliminary soil sampling and analysis are presented in Figures 2-8 through 2-11. Figure 2-8 provides a visual summary of locations sampled, Figure 2-9 depicts the distribution of radium-226 concentrations in soil, Figure 2-10 depicts thorium-230, and Figure 2-11 the distribution of total uranium concentrations. This preliminary data suggests that constituents are elevated in the drainage channel areas originating from north and east of the Section 4 Ponds, implying that a substantial portion of radionuclide mass in soils in the vicinity of the Section 4 Ponds is the product of mine drainage flow and suggesting that the paleochannel underlying the lined ponds (Figure 2-12) is a primary repository for mine drainage contamination.

There may be a minor contribution to surface soils by windblown constituents from pond sediment and, possibly, from minor breeches of the pond lining. These breeches were caused by severe weather and wind agitating exposed liner material and producing small rips or holes in the lining. Holes tend to be in exposed areas on the pond berms and were repaired upon discovery. Appendix D contains reports documenting these events.

2.4. GROUNDWATER

Unsaturated conditions in alluvial materials prior to mining activities have been documented by the State of New Mexico Groundwater Protection Bureau in publications (see for example, Bostick, 1985) that also describe the establishment of Alluvial saturation by mine-dewatering discharges during development of the numerous mines in the vicinity. As described above, voluminous surface flow, beginning in 1957 and continuing until the early 1980s, infiltrated sediments that currently underlie the Section 4 Ponds.

Saturation of soils in the paleochannel underlying the future Section 4 Ponds was observed during pond pre-construction investigations, confirming that groundwater flow in the alluvial materials had been established by 1979 (more than 20 years after mine discharge had begun). The report describing soil borings can be found in Appendix D-2.

Figure 2-13 shows the outline of the ponds and the location of monitor wells installed in 1980, immediately after the construction of the second set of ponds. Monitor wells were screened so that groundwater could be sampled and water levels measured. Monitoring data indicates that wells MW-1 through MW-11 had gone dry by 1988, with the exception of MW-6, which went dry in 1989, and MW-7 that went dry in 1992.

MW-7 is located in the deepest part of the paleochannel and is the most downgradient of this group of wells was the last of the group to go dry. Figure 2-14 is a plot of water level trends in MW-7 from the beginning of data availability in 1982 to the point that it went dry. Similar plots are presented in Figures 2-15 through 2-18, depicting water level trends in wells MW-14, MW-17, MW-21, and MW-24, chosen as the closest to the center, or deepest portion of the paleochannel, in a series of wells - each progressively downgradient of the other.

This progression describes the history of groundwater in the paleochannel. Water levels decline steeply in monitor well MW-7 (Figure 2-14), from the highest observed values in 1982 to no water in 1991. In MW-14, the next monitor well downgradient, the decline is slower (Figure 2-15). The water level decline in monitor well MW-17 (Figure 2-16) resembles that in MW-7. It may not be located in the deepest part of the channel so may not be placed to effectively measure the deepest groundwater. Monitor well MW-21 did not go dry until late 1993 or early 1994 and water levels declined much more slowly than in upgradient wells (Figure 2-17). Water levels in monitor well MW-24 did not go down initially (Figure 2-18). Instead, they climbed to a high in 1991 before declining to current levels.

These data demonstrate that impacts to soil and the presence of groundwater beneath the lined Section 4 Ponds occurred prior to pond construction. The mass of constituents of concern in soils beneath ponds is the result of more than 30 years discharging mine water from uranium mines upgradient of the site. Processes operating during that time period stored a large amount of mass in soils beneath the ponds. Soil investigations, including gamma surveys and laboratory analyses of soil samples have documented the surface expression of mine discharge water and traced it back to mine discharge sources.

Groundwater was not present in alluvial materials when mining began and is the direct result of mine water discharge. Aerial photographs taken prior to pond installation show the development of vegetation downgradient of uranium mines, but vegetation is not prominent in aerial photographs taken in 2004 (Figure 2-6). This data gives a clear indication that mine-discharge induced groundwater is dissipating and is essentially gone. Water level trends in monitor wells completed in alluvium beneath the ponds give confidence that groundwater put in place by mine water discharge has dissipated; no longer posing a risk to human health and the environment.

Rio Algom is coordinating with the State of New Mexico Ground Water protection Bureau on a well plugging and abandonment plan to ensure relocation activities do not result in ground water impacts. Therefore, in an effort to facilitate closure activities and prevent subsurface impacts resulting from relocation activities, Rio Algom proposes the following:

- All monitor wells currently located within the footprint of the existing ponds (i.e., on the pond berms) will be plugged and abandoned. This action limits migration of potential contaminants down the well casing, and eliminates potential conduits for surface runoff during storm events. Abandonment activities will be documented.

- Monitor wells located outside of the Section 4 Pond footprint, that will not impede the relocation activities from proceeding in a safe and efficient manner, will remain intact during the relocation phase in order to monitor any impacts that are occurring as a result of the work.

- Following completion of the sediment relocation, all remaining wells will be plugged and abandoned. Wells will be plugged in such a manner as to prevent migration of surface runoff or ground water along the length of the casing. Where possible, the PVC casing will be removed and the remaining hole will be filled with bentonite/grout to the projected final surface elevation.

3.0 OPERATIONAL CONDITIONS

3.1. SITE OPERATIONAL HISTORY

The ponds are a component of Rio Algom's uranium ore processing mill and are licensed by the U.S. Nuclear Regulatory Commission under Source Material License SUA-1473.

Pond 9 was built in 1976 to provide an evaporation area of approximately 25 acres (Figure 3-1). In 1976, construction was also initiated to install the Section 4 evaporation ponds. These evaporation ponds were constructed in two (2) phases and completed in 1979. Overall, the Section 4 Ponds provide an evaporative area of 256 acres with a total holding capacity of 1570 acre-feet. The lined ponds were used to dispose of excess process solutions associated with the milling operations.

The primary purpose of the Pond 9 and Section 4 Ponds were to evaporate liquid wastes generated from the Ambrosia Lake (RAM) mill. The ponds could receive up to 1,660 gallons per minute (gpm) of solutions from the mill wastewater management system. Most of the wastewater from the mill processing facility was spent raffinate solution from the extraction circuit. Raffinate is a barren acid-water solution previously used in the process to help dissolve the uranium from the host ore.

Another source of wastewater to the evaporation ponds was from the facility's ion exchange (IX) plant and consisted of backwash and resin regeneration solutions. An additional waste stream to the evaporation ponds was water recovered as part of the mill facility's on-going NRC-approved Corrective Action Plan (CAP). Also placed in the evaporation ponds for disposal were processing solutions associated with "Alternate Feed Materials". In September 1987, Rio Algom received approval from NRC to process alternate feed materials generated from the Sequoyah Fuels Corporation located in Gore, Oklahoma. The Section 4 lined evaporation ponds are a component of the environmental monitoring programs established at the site with results reported to NRC as part of the semi-annual effluent reports.

3.2. EVAPORATION POND CONSTRUCTION

The Section 4 evaporation ponds are sequentially numbered from #11 through #21 and are situated approximately two (2) miles southeast of Rio Algom's conventional mill facility primarily located on section 31, Township 14 North, Range 9 West (Figure 3-2).

The lined evaporation ponds at Section 4 were built during two construction phases. Ponds #11 through #15 were constructed during 1976 with Ponds #16 through #21 subsequently built in 1979. Initial construction used medium plastic clays as a bed for the evaporation ponds. This material was then covered with synthetic liner material. The berms and outer slopes of the ponds beneath the liners were constructed of local alluvial materials. It is likely that some of these local soils included those impacted by past mine drainage.

All soils used in pond construction were compacted to 95 percent maximum Standard Proctor Dry Density at or above optimum moisture content. Within the center of the pond embankments, the material consisted of a compacted clay center (core). The outer slope embankments were generally no steeper than 2½ H:1V, while the interior slopes are generally no steeper than 3H:1V. The tops of the berms were generally a minimum of 12 feet high with a three (3) foot freeboard design. The synthetic liner was placed directly onto the compacted soils.

Evaporation ponds #11 through #15 were constructed with a bottom liner made of 10 mil (one-thousandth of an inch) polyvinyl chloride (PVC). The side slopes were lined with 20 mil chlorinated polyethylene (CPE). Construction materials for evaporation ponds #16 through #21 consisted of 20 mil PVC material for the pond bottoms with the side slopes consisting of 36 mil "Hypalon" (CPE) with the liner reinforced with nylon scrim. In all evaporation ponds, the pond bottom liner was covered with a one (1) foot layer of alluvial soil upon completing construction to provide an additional measure of liner protection.

In conjunction with the construction of the evaporation ponds, a diversion channel was constructed along the eastern and southeast boundary of Section 4 Ponds to accommodate a flow of 405 cubic feet per second coming from the Voght Tank drainage area resulting from storm runoff.

Pond 9 was constructed adjacent to Pond 3 at the mill site on a shale point. The bottom of the pond is lined with ten mil PVC membrane and a foot-thick layer of alluvial soils were placed over the PVC membrane. The side slopes were lined with 20 mil CPE membrane.

3.3. EVAPORATION POND SYSTEM MANAGEMENT

Operational procedures limit the quantity of wastewater placed in any individual pond. The management program includes daily visual inspection and documentation of the pond system. The intent of inspections is to identify and correct any problems. Typical findings include identification and control of burrowing animals on the berms and identification and repair of liner or pipeline damage. Records are maintained of occurrences; correspondence and corrective action reports are enclosed in Appendix D-3.

The facility maintains emergency response capabilities including a rapid response trailer in the unlikely event of a major system failure resulting in the release of materials.

4.0 SURFACE RECLAMATION PLAN

4.1. OVERVIEW

Byproduct materials contained within the lined evaporation ponds will be relocated to Rio Algom's mill site. The pond sediments and soils from the berms and sub-liner that were affected by pond operations for Pond 9 and the Section 4 Ponds (11 through 21) will be stabilized on the Pond 2 area of the mill site (Figure 4-1). Following completion of the material relocation, the former lined pond areas will undergo final site survey activities in accordance with the methods and procedures approved by NRC as part of the approval of the site Soil Decommissioning Plan submitted on January 19, 2005. After completion and verification of the removal, the area will be stabilized by regrading and revegetating areas disturbed during the relocation effort.

4.2. POND SEDIMENT CHARACTERIZATON

Lined evaporation pond sediment samples were collected and analyzed to update the previous radionuclide characterization of the evaporation cells for their radium-226 and thorium-230 concentrations. The characterization data for radium-226 and thorium-230 concentrations within the evaporation ponds are shown in Table 4-1, with the commercial laboratory analytical results contained in Appendix E. This data will be used to develop an appropriate radon attenuation barrier design.

TABLE 4-1. RADIUM-226 AND THORIUM-230 CONCENTRATIONS

Location	Date	Ra-226 (pCi/gram)	Th-230 (pCi/gram)
Pond 9 (NW)	10/31/2003	80.2	175
Pond 9 (SW)	10/31/2003	71.5	269
Pond 11	4/25/2003	41	555
Pond 12	4/25/2003	43.8	720
Pond 12 (0-6")	5/27/1988	7.4	
Pond 12 (6-12')	5/27/1988	34	
Pond 13	4/25/2003	36.7	896
Pond 14	4/25/2003	14.8	1130
Pond 15	4/25/2003	23.4	520
Pond 15 (0-1.5")	5/22/1990		640
Pond 15 (1.5-12")	5/22/1990		1000
Pond 16	4/25/2003	31.3	365
Pond 16 (0-6")	5/27/1988	26	
Pond 17	4/25/2003	60.6	148
Pond 17 (0-1.5")	5/22/1990		310
Pond 17 (1.5-12")	5/22/1990		750
Pond 18	4/25/2003	63.5	840
Pond 19	4/25/2003	26.7	713
Pond 19 (0-1.5")	5/22/1990		490
Pond 19 (1.5-12")	5/22/1990		810
Pond 19 (0-6")	5/27/1988	28	
Pond 19 (6-12")	5/27/1988	7.4	
Pond 20 (0-1.5")	5/22/1990		1810
Pond 20 (1.5-12")	5/22/1990		2030
Pond 20 (0-6")	5/27/1988	28	
Pond 20 (6-12")	5/27/1988	26	
Pond 21	4/25/2003	33.6	1050
Average		**36**	**761**

4.3. CAPACITY AND VOLUME

4.3.1. Section 4 Ponds

The Section 4 Ponds were constructed to have an evaporation area of approximately 256 acres. The quantity of byproduct material contained within the ponds was determined through field measurements from multiple locations within each pond. These measurements indicate that the sediment thickness is highly variable with thicker sediment at the south end of each pond because of the slope of the topography. The range of thickness measurements of the pond sediments are shown in Table 4-2 and Figure 4-2.

TABLE 4-2. SECTION 4 PONDS SEDIMENT QUANTITIES

Location	Range of Measured Sediment Thicknesses (in)	Calculated Volume of Sediment (cy)
Pond 11	23 - 75 inches	163,000
Pond 12	27 - 64 inches	134,400
Pond 13	28 - 64 inches	95,600
Pond 14	27 - 40 inches	93,150
Pond 15	18 - 67 inches	125,100
Pond 16	21 - 63 inches	94,300
Pond 17	17 - 54 inches	87,050
Pond 18	15 - 32 inches	67,300
Pond 19	12 - 71 inches	133,900
Pond 20	26 - 65 inches	173,350
Pond 21	18 - 27 inches	68,450
TOTAL		**1,235,600**

Sediment volumes were cross-checked using the "as-built" pond information developed by Jacobs Engineering Company (1976) and Kerr McGee Nuclear Corporation (1980). Volumes within evaporation ponds #11 through #21 was estimated to be approximately 1,235,600 cubic yards (cy). This quantity is exclusive of a 6 inch soil layer beneath the bottom liners of the ponds. However, the total volume of materials to be placed in the Pond 2 cell includes this volume because the mechanical equipment (scrapers) to be used in the excavation in removing the pond liner will remove approximately six-inches of soils beneath the liner. The volume of six inches of soils to be removed below the pond liners is approximately 206,500 cubic yards.

Most of the earthen material within the evaporation pond berms is anticipated to be "clean" material as it is beneath and protected by the synthetic liner material. The berm volume of earthen material was determined from the "as-built" information. For construction purposes, the volume of contaminated soils for each berm was estimated and the total was 264,600 cubic yards, which is included in the disposal volume design of the Pond 2 disposal cell. This volume is approximately 43 percent of total volume of the Section 4 berms (620,550 cy). The impacted berm material will be used as a consolidation material to enable the placement of the radon cover material over the byproduct sediment material at the Pond 2 location.

In addition to the impacted berm and sub-liner materials, for construction estimation purposes, it was assumed a 50 percent contingency for removal of "hot spots" in areas of localized impact would be removed in addition to the six inches beneath the pond liners. Included in this 50 percent contingency is for removal of windblown impacts outside of the footprint of the ponds. The volume of these contingency soil materials is 103,500 cubic yards.

4.3.2. Pond 9

Pond 9 has an evaporation area of approximately 25 acres. The quantity of byproduct material contained within the ponds was determined through field measurements from multiple locations within the pond. The range of thickness measurements of the pond 9 sediments is shown in Figure 4-3.

The volume of Pond 9 sediments was estimated to be approximately 100,000 cubic yards. As in the Section 4 ponds, this quantity is exclusive of a six-inch soil layer beneath the bottom liners of ponds. Excavation will include the six-inch soil layer, with an added volume of 20,200 cubic yards.

For construction purposes, the volume of impacted soils for berm was estimated 10,000 cubic yards. In addition to the impacted Pond 9 berms and sub-liner materials, a 20 percent contingency was assumed for removal of additional impacted soils; this volume is 26,000 cy. Therefore, the total estimated volume of materials to be relocated to the Pond 2 disposal area from Pond 9 is 156,200 cy.

The total quantity of byproduct sediment, berm material, sub-liner soils, and other soils to be excavated and relocated is estimated at 1,966,200 cy and is summarized in Table 4-3.

TABLE 4-3. ESTIMATED VOLUME OF MATERIAL TO BE RELOCATED TO POND 2

Material Source	In-place Volume (CY)
Evaporation Ponds	1,235,600
Impacted Berm Material	264,600
Sub-Liner Material (6 in.)	206,500
Hot Spot and Wind Blown Material	103,300
Pond 9	156,200
TOTAL	**1,966,200**

4.4. EXCAVATION CONTROLS

The purpose of excavation control monitoring is to guide excavation activities through the use of radiological measurements along with other field observation techniques in an effort to minimize the amount of material that will be excavated.

As described within Section 2.3.1, the land area where the lined Section 4 Ponds are located has been contaminated by historic mine dewatering activities. This contamination is demonstrated by soil sampling described in Section 2 of this document. Because Pond 9 is located adjacent to and down gradient of the main millsite tailings pile, there may be impacts from past milling operations prior to construction of Pond 9.

Following removal of the pond sediments and liners, preliminary field characterization of the soils below the pond liners will commence through a combination of visual observation, radiation surveying, and direct soil sampling. Radiation surveys and soil sampling will only be used to guide field construction work.

Visual observation methods include observing the excavated area for moisture in the soil, which may be an indication of pond impacts. An additional technique that will be used to delineate pond impacts will be a simple acid test on soils beneath the liner.

This simple yet effective acid test utilizes the fact that mill process solutions contained within the lined ponds were highly acidic (pH <1 s.u.) and the local soils are characteristically alkaline (petrographic analysis indicates that the calcium carbonate minerals in soils commonly exceed ten percent of the total volume of a sample – see Section 2.2.1). Soils that are or were in contact with pond solutions can be expected to be depleted in calcium carbonate due to reaction with the acidic pond solutions. Soils impacted by pond solutions would be expected to be non-reactive to acid and not exhibit any visible reaction (i.e., effervescence) to dilute hydrochloric acid. This test relies on the known transport characteristics of constituents of concern in pond solutions. For example, while thorium and radium can be dissolved and transported at a low pH, they tend to precipitate or be adsorbed at higher pH, limiting transport.

This simple acid test will also aid in the differentiation of mine water impacted soils. Mine water discharged within the Ambrosia Lake area typically exhibited a slightly alkaline geochemistry with a pH of approximately 7.7 s.u., which would not reduce the carbonate content (i.e., fizzing capability) of the soils and could increase carbonate concentrations in soil. Therefore, in areas where the source of elevated radiological conditions can not be definitively determined, soils containing elevated radiation levels that exhibit effervescence (fizzing) to dilute acid will be tagged as mine impact while soils that do not exhibit effervescence conditions will be tentatively flagged as pond impacted.

The lined ponds were used to evaporate the liquid waste stream from Rio Algom's acid leach uranium processing mill. The acid leach process resulted in the thorium-230 component within the ore to become dissolved and present in the liquid fraction of the discharge. These solutions were pumped first to Pond 9 then overflow volumes were sent to the Section 4 Ponds for evaporation. This characteristic allows for the development of a method to differentiate between impacts from the ponds and impacts from the historic mine drainage activities.

Mine waters in the Ambrosia Lake area typically contain elevated uranium and radium-226 concentrations requiring ion exchange to remove these radionuclides prior to discharge. Prior to the use of ion exchange treatment technology in the Ambrosia Lake area, these untreated waters were discharged directly to the surface drainages. Soils below the ponds that have been impacted by pond solutions or windblown deposited pond sediments on the ground surface would be expected to contain a thorium-230 fingerprint, which would indicate impacts due to pond operations. Rio Algom can utilize this preliminary technique to differentiate between residual radionuclides associated with byproduct material from those attributable to mine activities.

4.5. RELOCATION OF MATERIALS

4.5.1. Section 4 Pond Material

The sediments from ponds #11 through #21 will initially be consolidated at the Section 4 pond location. Materials that will facilitate consolidation include impacted berm material, the 12-inch sand layer located on the top of the PVC or Hypalon liner, and any impacted soils below the PVC or Hypalon liner, to produce a mixture that is amenable to hauling. The mixture will be transported to the disposal area located at the north end of Pond 2 through the use of off road haul trucks.

A dedicated haul road will be utilized to transport the materials from the Section 4 Pond area to Pond 2 (Figure 4-1). This road will cross the public highway via an overpass, which greatly reduces public safety concerns associated with crossing the highway. The overpass will be designed and constructed to ensure safe travel for the haul trucks transporting the pond sediments from Section 4 to Pond 2. An assessment of the bridge construction project was performed by the New Mexico Department of Transportation and concluded that the proposed highway crossing project will have no significant impact on the quality of the human or natural environment, either singularly or cumulatively. (Appendix F). Additional analysis of potential impacts are discussed in Section 4.8.

4.5.2. Pond 9 Material

Sediments and contaminated materials to be relocated from Pond 9 will be moved to the Pond 2 area on the same dedicated haul road coming from the Section 4 Ponds area. Depending on the alternative route selected (Figure 4-1), a short road connecting Pond 9 to the main haul road will be constructed on existing disturbed areas at the site. The Pond 9 haul road does not require crossing Highway 509.

4.5.3. Environmental Protection

To ensure that the pond sediment material does not create potential contamination concerns during the relocation phase, radiation surveys will be performed along the travel route prior to commencement of activities and monthly during hauling operations. The anticipated duration of the haul is estimated to encompass 18-24 months. Additional surveys will be performed if any spillage from the trucks is discovered with appropriate corrective actions implemented.

Following the completion of hauling operations, the highway crossing is scheduled for removal, unless otherwise requested by the State Department of Transportation to leave the crossing intact. Construction materials will either be released for unrestricted use or disposed on site. The entire haul route including the highway right-of-way will be surveyed to determine radiological conditions. Areas requiring reclamation will be cleaned up as necessary with the objective of releasing the haul route to conform to the requirements established by NRC as part of the approval of the site Soil Decommissioning Plan submitted to NRC on January 19, 2005.

4.6. DISPOSAL LOCATION

The design of the disposal cell with regard to stability, long-term performance, radon barrier and erosion protection, will be in compliance with 10 CFR 40 Appendix A criteria and NRC guidance document *Standard Review Plan for the review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978,* June 2003. This final design plan for the Pond 2 area will be submitted under separate cover and is expected to be submitted in January 2005. The material handling processes that will be used are described below.

After hauling to the Pond 2 area (Figure 4-1), the mixed pond sediments and soils will be combined with other impacted soils or amended with borrow soils. The materials will be adjusted for moisture content and compacted according to project specifications. At the disposal site, the relocated materials would be placed on a prepared surface at the Pond 2 area. This area has been previously capped with a minimum three-foot-thick compacted radon attenuation cover.

Any existing rock cover will be removed and stockpiled for use in construction of the erosion protection rock cover. Rock will also be removed and stockpiled from the west side-slope of the Pond 1 disposal cell so the Pond 2 cell will be contiguous with the Pond 1 cell. The top surface of the Pond 2 cell will be slightly lower than Pond 1 and sloped to prevent any run-on of surface water to Pond 1. Pond 1 has already been shaped to prevent surface water runoff to the west; all water from the top surface of Pond 1 flows to the south discharge channel.

There is sufficient capacity available at the north end of Pond 2 to take the lined pond materials. Should additional capacity be required, this is available by removing rock currently placed on the reclaimed southern part of Pond 2, placing the additional materials there, and replacing the rock cover after construction of the radon barrier.

Following placement, the relocated pond sediments and contaminated soils will be covered with a compacted clay cover (radon barrier), frost protection layer, and rock surface layer for erosion protection. Final design and required thickness of the radon barrier layer will be dependent on other byproduct materials that may be placed in the Pond 2 disposal cell. Surface water run-off will be collected as necessary in channels and discharged either to the northwest or to the south where the flows will be dissipated into historic drainage basins.

4.7. RESTORATION OF POND AREAS

After completion of the relocation of the pond sediments and other associated soils to the Pond 2 mill site disposal cell, and following verification of successful reclamation as part of the final site survey,, the area of the Section 4 Ponds will be regraded as shown on Figure 4-4. The Pond 9 area will also be regraded and uncontaminated soils remaining within the berms and surrounding areas will be used to provide soils for contouring to achieve positive drainage through the area. Slopes through the Section 4 regraded area will generally be approximately one percent but in the transition areas between the former pond areas the slopes will range from two to five percent (Figure 4-5). Each area will also be revegetated.

Revegetation activities will consist of a three step process involving: 1) soil disking; 2) drill seeding/broadcast spreading; and 3) hay/straw mulching and crimping. Compacted areas such as roads and parking areas will either be scarified or they will be disked to a depth of 1.5 feet prior to the revegetation process in order to facilitate revegetation efforts.

Seeding rates, based on a pure live seed (PLS) basis, will be established at 14 to 15 pounds per acre. Mulching rates will be established at two tons of hay/straw per acre. The area will be crimped following seeding and mulching activities.

Rio Algom Mining LLC, Seed Mixture

Species	Seed Mix (%)
Blue Grama	20
Indian Ricegrass	15.5
Native Western Wheatgrass	20
Sideoats Grama	20
Galleta	2
Sand Dropseed	2.5
Alkali Sacaton	3
Intermediate Western Wheatgrass	4
Fourwing Saltbush	5
Winterfat	4
Forbs[1]	4
1 - Two forb species will be selected from the following in equal proportions (i.e., 2% each): 1) blue flax; 2) California poppy; 3) purple prairie clover; 4) yellow sweetclover; 5) desert globemallow; or 6) purple aster.	

4.8. CUMULATIVE EFFECTS

Construction activities associated with site decommissioning are occurring with the objective of transferring the site to the U.S. Department of Energy. The lined pond relocation project is one of these activities. Potential impacts resulting from this project above and beyond existing conditions are described below.

4.8.1. Noise

Incremental increases to existing noise levels resulting from the proposed action (other site activities, highway traffic) will occur. This is considered a minimal impact due to the remote location and sparsely populated area.

4.8.2. Air

The most significant impact resulting from the proposed action is expected to be from fugitive dust. Fugitive dust will be mitigated through the use of dust suppression methods on active disturbed areas associated with the proposed action. The site Health, Safety and Environment Management System provides adequate assurances to control impacts to the environment. Ambient air monitoring stations will be installed to collect data to demonstrate effective control measures are implemented and effective.

4.8.3. Traffic and Accidents

The action will result in increased traffic to and from the project site and on-site activities. However, increased traffic levels resulting from site employees will be far below historic traffic levels observed during the full operations of the facility. For on-site activities, the project design minimizes the potential for traffic accidents occurring between project personnel as a result of dedicated haul roads to maintain segregation of traffic. Interaction with traffic from the general public is minimized through the construction of an overpass across the public highway.

4.8.4. Socioeconomic Impacts

The proposed action will result in a temporary increase to the employment levels in the Grants area and positive increases in the local economy for the duration of the proposed project (18-24 months).

4.8.5. Cultural and Historic Resources

The proposed action will be confined to existing disturbed areas and will not result in adverse impacts to cultural and historic properties.

4.8.6. Flora and Fauna

The proposed action will be confined to existing disturbed areas and will not result in adverse impacts to habitat, including threatened and endangered species (see Section 2.2.1).

4.8.7. Radiation

The proposed action will reduce overall radiological exposure potential in the area by consolidating materials in one disposal facility. The proposed action will result in increased habitat at Section 4. The site Health, Safety and Environment Management System provides adequate assurances to control radiological impacts to employees, the public and the environment.

Dust suppression practices will minimize airborne concentrations of pond sediments thereby minimizing inhalation risks. Pond sediment radium-226 concentrations will not result in elevated ambient radon concentrations during the life of the project. Passive radon monitors will be installed at the ambient air monitoring stations to ensure compliance with radiation exposure requirements.

4.8.8. Aesthetics

The proposed action will improve the overall aesthetics of the area by the elimination of the Section 4 Ponds. Following removal of the ponds, the Section 4 area will be restored and be available for grazing and other uses.

4.8.9. Surface Water

The proposed action is designed to control potential impacts to surface water during the relocation activities by diverting and containing run-off. Elimination of the ponds will result in returning the surface drainage pattern at Section 4 that is compatible to the surrounding area.

4.8.10. GroundWater

The proposed action will eliminate future impacts to groundwater the from Section 4 Pond area. The alluvium in the area was unsaturated prior to mine discharges in the area and groundwater levels are diminishing and are returning to pre-mining conditions (see Section 2.3.1)

4.8.11. Cumulative Impacts

The proposed action will result in an overall improvement to the land use in the Ambrosia Lake area. The activities proposed are temporary and are not expected to damage the environment in the long term. The most significant impact is expected to be from fugitive dust, which will be controlled by standard dust suppression methods including watering of haul roads and limiting vehicle speeds.

Areas disturbed by the project will be restored and revegetated, as much as reasonably possible, to pre-existing conditions. The proposed project will result in benefiting the local economy for the duration of the project.

There are other uranium processing facilities in the region; however, these sites have completed remediation activities (DOE Ambrosia Lake site) or are at distances that preclude additive impacts to this proposed project (Homestake, Bluewater). The DOE Ambrosia Lake UMTRA Title I site which has been remediated is approximately one mile north of the Section 4 Ponds and is currently in a surveillance and monitoring phase. There are two former Title II uranium milling and processing sites over ten miles from the Rio Algom mill site. The Homestake – Grants Reclamation Project is approximately 14 miles south and is performing ongoing groundwater corrective actions and continued tailings dewatering activities. The ARCO Bluewater mill site is three miles west of the Homestake site and has been transferred to the DOE, and is currently in under their surveillance and monitoring program.

5.0 HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION

5.1. OVERVIEW

The contaminated byproduct sediments contained within the lined evaporation ponds will be relocated to the Pond 2 area of the mill site. Design of the disposal cell and cover will be finalized and submitted under a separate design document.

5.2. HEALTH, SAFETY AND ENVIRONMENTAL PROGRAM

Closure of the lined evaporation ponds will be accomplished through implementation of an overall health and safety program and continuation of the health physics and environmental monitoring program. Appendix G-1 contains the current Health Physics and Environmental Monitoring Program Manual implemented at the site. Coordination and integration will occur with contractor health and safety commitments to ensure protection of employees, the public and the environment.

Key systems, programs and procedures addressing the overall health and safety program implemented at the site include the BHP Billiton Health Safety Environment and Community Management System, Rio Algom Crisis Management Plan, Rio Algom Contractor Management System, and pertinent response procedures that address possible emergency scenarios that could possibly occur at the site. These include fire, tailings system failure, transportation accident, and medical emergencies.

5.2.1. Safety Program

Rio Algom's existing safety program will remain in effect during lined pond closure activities. This program encompasses all aspects of potential safety hazards that are expected to occur or exist at the site with safety rules and procedures developed to ensure employee safety. Examples of the programs and procedures that will be utilized will include: 1) first aid and medical emergency procedures; 2) evacuation procedures; 3) fire control procedures; 4) confined spaces; 5) lock-out tag-out; 6) hot work permit system; 7) working from elevated locations; 8) workplace and equipment inspections; and 9) visitor safety procedures.

During lined pond closure activities, a pre-shift meeting/briefing will be held on a daily basis, or prior to the start of a new activity. This meeting will provide the opportunity for management to review the previous days' work performance, outline the current task and objectives, and to review exposure monitoring results. This assures worker understanding of the task hazards and procedures to be followed; and will provide an efficient means to communicate worker questions and recommendations. Additionally, employees have the ability to stop work if an unsafe condition exists.

5.2.2. ALARA Program

Due to the potential radiological hazards associated with lined pond closure activities, a comprehensive ALARA (As Low As Reasonably Achievable) radiation safety protection program will be adhered to which consists of the following elements:

- Management Control
- Radiation Safety Administration
- Radiation Safety Training
- Standard Operating Procedures/Radiation Work Permits
- Radiation Monitoring
- Bioassay Program
- Personnel Contamination Control and Protective Clothing
- Contamination Survey and Control Including Material Salvage
- Respiratory Protection

- Instrument Control
- Security

All lined pond closure activities will be performed with the intent of maintaining radiation exposures to workers, the public, and the environment as low as is reasonably achievable (ALARA). To assure worker exposures are maintained as low as reasonably achievable, Rio Algom will continue its existing ALARA program during lined pond closure activities to ensure the activities are performed in compliance with the ALARA principal as well as conducted in a safe and prudent manner. The facility ALARA Policy is contained within Section 2 of the Health Physics and Environmental Programs Manual (Appendix G-1).

The individual components of the ALARA program listed above, along with their proposed plans for implementation during lined pond closure activities, are discussed below.

A. Management Control

Primary individuals responsible for the implementation and adherence to proper procedures and radiation protection programs include the Radiation Safety Officer (RSO) and on-site General Manager. The on-site RSO will meet all the qualifications pursuant to NRC Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be As Low As is Reasonably Achievable."

The RSO will work closely with the on-site General Manager and Contractor Health and Safety Representatives to ensure the established radiation protection measures are properly implemented and maintained. The RSO is responsible to assure the work areas are inspected to verify compliance with all applicable requirements. The RSO is also responsible for the collection and interpretation of the monitoring data, including data from the industrial and radiological safety monitoring programs. The RSO will recommend protective measures, as necessary, to improve any and all safety-related controls.

The RSO has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or may not be in conformance with NRC requirements. The RSO is also responsible for administering the ALARA program and will be active in the review and approval of any plans for dismantling of facilities to assure that the procedures do not adversely affect worker protection.

B. Radiation Safety Administration

Documented inspections for radiation safety hazards will be conducted daily by the RSO or designee during pond closure of the facilities within the restricted area. Results of these inspections will be reviewed and any recommended corrective actions will be implemented as necessary.

Once per month during the lined ponds closure, the RSO will submit a written report to the General Manager and Corporate Manager for Radiation Safety, Licensing & Regulatory Compliance summarizing the pond closure activities. The report will address topics such as the work performed, monitoring results, discuss any trends or anomalous conditions, identify any conditions potentially needing correction and make recommendations necessary to assure continued worker safety and to maintain exposures ALARA.

C. Radiation Safety Training

All workers who are not already trained will be given general radiation safety training that complies with the provisions of 10 CFR 19.12, Instructions to Workers. Female workers will also be instructed in the potential health problems associated with prenatal radiation exposures outlined in NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." A written test addressing applicable principles of the radiation safety program will be administered to each worker and test results will be reviewed to ensure worker understanding of appropriate protection practices. Results of testing will be maintained in each worker's file. Retraining will occur at least on an annual basis, or as needed to ensure adequate understanding of radiation hazards. The facility radiation safety training program is included in Section 2 of the Health Physics and Environmental Programs Manual (Appendix G-1).

In addition, task training will be performed and documented as necessary in accordance with specific hazards identified with each work activity.

D. Standard Operating Procedures/Radiation Work Permits

All pond closure procedures will be conducted under the auspices of either a Standard Operating Procedure (SOP) or a Radiation Work Permit (RWP) procedures. The SOP and/or RWP procedures will describe and identify the potential hazards to assure appropriate precautions are implemented and maintained for worker protection. The SOP or RWP will include:

- Identify areas where activities will be conducted;
- Perform inspections and monitoring surveys where appropriate, to define potential radiological hazards;
- Specify precautions to be taken and monitoring to be performed. Precautions may include wetting areas to minimize airborne contamination, access restrictions, respiratory protection or protective clothing, and time restrictions;
- Provide task-specific training as appropriate to assure exposures are ALARA and activities are conducted in a safe manner;
- Specify that any anomalous conditions is to be reported immediately to the RSO for further investigation, if warranted.

E. Internal and External Radiation Control

Prior to initiation of work activities, based on pre-work surveys by the RSO or designee, the SOP or the RWP will specify the need for personal lapel sampling and area sampling for airborne radioactive materials. Work practices shall be selected in such a way so as to maximize employee health and safety.

External gamma radiation exposure to all workers physically involved with lined pond closure work activities will be monitored by use of approved personnel dosimeters. The dosimeters will be exchanged quarterly.

F. Bioassay Program

The objective of the bioassay program is to provide information to support the effectiveness of the overall health physics protection program implemented at the facility. The provisions within the bioassay program are in accordance with NRC's Regulatory Guide 8.22, "Bioassay at Uranium Mills." The existing Bioassay Program will remain in effect during pond closure activities with the following modifications.

- Employees/workers associated with lined pond closure activities shall provide a baseline bioassay sample prior to performing any lined pond closure activities.
- Employees/workers associated with lined pond closure activities shall provide a final bioassay sample upon completion of pond closure activities.
- Bioassay samples shall be submitted monthly unless otherwise determined by the facility RSO.

G. Personnel Contamination Control and Protective Clothing

All workers who will be directly involved with lined pond closure activities involving handling contaminated materials will be required to wear protective work clothing. This clothing (cloth or disposable clothing, e.g., Tyvek suits) will be either laundered or disposed of on-site.

For work where a higher probability of contamination exists, workers will be use additional protective clothing, such as rubber gloves and rubber steel-toed boots. Rubber boots will be washed on-site. All disposable clothing will be buried on site.

The existing *Personnel Contamination Control Protocol* established for the facility will remain in effect during lined pond closure activities (Appendix G-2). This policy requires that employees and workers involved with lined pond closure work within the restricted area will be required to either shower or monitor themselves for contamination prior to leaving the property.

H. Contamination Survey and Control

Designated eating areas, change rooms, and offices will be surveyed on a weekly basis in accordance with NRC Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities" during lined pond closure activities. An action level of 1,000 disintegrations per minute ("dpm") removable alpha per 100 cm^2 will prompt decontamination procedures and subsequent contamination surveys. Results of all surveys will be documented and maintained for future inspection.

Surface contamination surveys shall be performed before potentially contaminated equipment is removed for unrestricted release. The surface contamination limits specified within Section 2.7 of NRC Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities" will be used to control release. The existing equipment release procedures established at the facility will be utilized to perform the necessary surveys. Records of all material released shall be maintained.

To control the likelihood of materials leaving the area without appropriate release surveys being performed, parking areas for personal vehicles shall be maintained outside the restricted area. Additional parking areas may be established to facilitate movement in and out of the restricted area.

I. Respiratory Protection

If respirators will be used for reducing exposures, they will be used in accordance with provisions of NRC Regulatory Guide 8.15, "Acceptable Programs for

Respiratory Protection" and Subpart H of 10 CFR Part 20. Rio Algom's existing SOP for the use of respiratory protection, included in Appendix G-3, encompasses all components of a respiratory protection program including use of engineering controls where feasible prior to using respiratory protection equipment, fit testing, cleaning and maintenance, medical evaluations, training, and program evaluation.

When respirators are used in accordance with Regulatory Guide 8.15, allowances/credit may be taken for respirator usage in determining internal exposures to airborne radioactive materials. Respiratory protection equipment shall be surveyed for removable alpha contamination following cleaning and will be less than 100 dpm per 100 cm^2 prior to being reused.

J. Instrument Control

All radiation survey and sample analysis instruments will be calibrated on at least an annual basis or following repair. Function checks will be conducted daily when an instrument is to be used. Instruments indicating problems with calibration or operation, will be taken out of service, repaired and recalibrated prior to being placed back into service.

K. Security

Rio Algom maintains a 24 hour on-site contract security service. In addition to the security controls, access is controlled through posting and fencing, which will be maintained until surface reclamation is completed.

All visitors are required to register at the offices or security station and are not permitted within the restricted area without proper authorization. Where appropriate, visitors will be instructed in radiation safety requirements specific to their project activities. All visitors touring the restricted area will be escorted by a Rio Algom representative who is properly trained and knowledgeable about potential radiation safety hazards associated with lined pond closure. Parking for visitors and personal vehicles will be available outside the restricted area.

Copies of applicable security procedures associated with emergency situations (fire, illness or injury, etc.) and visitor controls are incorporated in Rio Algom's site Standard Operating Procedures.

5.2.3. Health Physics Monitoring Schedule

NRC License Condition #10 contains commitments for implementation of a comprehensive radiation safety program for the site including a health physics and environmental monitoring program.

Collection and analysis of data obtained during lined pond closure activities will continue to be performed through the use of existing procedures that have been established for the individual tasks and activities, as required by NRC License Condition #16. These written procedures, which include in-plant and environmental monitoring, bioassay, and instrument calibration, are reviewed and approved by the facility RSO on at least an annual basis to ensure that proper and current radiation protection principles are being applied. An action level of 25% of the Derived Air Concentration ("DAC") will be used for air samples to ensure exposures are ALARA. The following monitoring program will be utilized during lined pond closure activities.

A. Airborne Dust Surveys

General air sample locations will be determined by the facility RSO and will represent those areas where employees/workers are most likely to become exposed to airborne concentrations as a result of lined pond closure activities. At a minimum, one (1) general area air sample will be obtained on a weekly basis that is representative of the active work areas.

Although it is anticipated that the majority of the work will be performed by mechanized equipment operated by workers within enclosed cabs, breathing zone air sampling (lapel sampling) will be used to monitor intakes of individual workers during potential high-exposure jobs. These jobs will be performed under an RWP. Analysis of air samples collected under an RWP will be completed within two working days after sample collection to permit prompt corrective action, if warranted.

B. Radon Daughter Surveys

No routine sampling will be performed as the work activities will be conducted in an outdoor environment. In the event special work requires monitoring for radon daughters, a radiation work permit shall be issued that will include a radon daughter monitoring component.

C. Surface Contamination Surveys

The primary radiological hazard that may be encountered during lined pond closure is residual radioactive materials that could become airborne. Appropriate contamination control practices will be implemented to minimize the potential for spreading and tracking contamination in the work areas.

Contamination surveys, consisting of representative sampling, shall be conducted on a weekly frequency in the following areas: 1) Active Change rooms; 2) Guard Office; 3) Active Lunchrooms; and 4) Administrative Offices (including contractor), and random selection of Company and contractor vehicles.

To ensure that the pond sediment material does not create potential contamination concerns during the relocation phase, contamination surveys will be performed along the travel route prior to commencement of activities and monthly during hauling operations. The anticipated duration of the haul is estimated to encompass 18-24 months. Additional surveys will be performed if any spillage from the trucks is discovered with appropriate corrective actions implemented.

D. Personnel Contamination Surveys

Random personnel contamination checks are made by members of the health physics department when employees/workers have finished their work shift and are preparing to go home. The random personnel scanning results are recorded and if the activity exceeds the action levels, the individual will be instructed to either re-shower, wash the affected area, or remove any contaminated clothing. Personnel contamination limits are deemed to be acceptable if the total alpha activity is below 1,000 dpm per 100 cm^2 for skin and clothing. Contamination limits acceptable for soles of shoes for total alpha activity is 5,000 dpm per 100 cm^2. These levels are consistent with Regulatory Guide 8.30, Section 2.6.

Random surveys will be performed on employees and contractors exiting the work areas at the end of the work shift a minimum of three times per week (based on a standard 5 day work week). Surveys will be documented and the results will be evaluated to determine the effectiveness of the contamination control practices that are established for the project. Based on this evaluation, the RSO may amend the survey frequency commensurate with the anticipated likelihood for personnel contamination to occur.

The existing Company *Personnel Contamination Control Protocol*, requires employees and workers to either shower or self monitor themselves prior to leaving the facility. For those individuals who do not shower, an alpha meter is available at the exit of the restricted area for conducting and documenting the contamination monitoring prior to leaving the restricted area at the end of the shift. All employees are trained in the proper use and operation of the radiation survey instrument during the initial indoctrination course and once again during the annual refresher.

E. External Gamma Radiation Surveys

Although it is anticipated that the majority of the work will be performed by mechanized equipment operated by workers within enclosed cabs at some distance to potential external radiation sources, a gamma radiation survey of the general work area shall be performed just prior to the initiation of lined pond closure activities. The survey shall provide sufficient data to provide a representative indication of the external radiation exposure potential in the work areas.

In addition to performing gamma radiation surveys to ascertain potential external exposures, a personnel dosimetry program will be utilized to record actual external radiation exposures received by employees and workers. NVLAP accredited dosimetry devices are issued to all employees except to office workers. Dosimeters will be distributed quarterly to all employees/workers. All dosimetry used for employee exposure purposes shall be acquired through and analyzed by a NVLAP accredited laboratory. In case of lost or damaged dosimeters, doses are estimated taking into consideration of the historical doses for that job position and the employees' previous exposures.

To minimize the possible exposure of a fetus, dosimeters worn by females are collected and analyzed monthly with special instructions given to all female employees during the initial hiring period. The instructions follow Regulatory Guide 8.13. In case of pregnancy, the employee exposure would be limited to 0.5 rem during the gestation period.

5.2.4. Environmental Monitoring Program

The environmental surveillance program for the Ambrosia Lake RAM facility includes routine monitoring and sampling of air, water, soil, and vegetation in the vicinity of the site. The programs are designed to provide maximum surveillance for environmental control and are based on many years of monitoring experience in conjunction with numerous regulatory agencies suggested practices.

Monitoring programs will include air particulate, ambient gamma radiation, ambient radon, soil, sediment, and vegetation monitoring on a frequency described within the facility Health Physics and Environmental Programs Manual.

During lined pond closure activities, the environmental monitoring program will be slightly expanded to ensure that data is obtained from the closure activities occurring at the lined ponds. This expansion will consist of installation and operation of two continuous operating particulate air monitoring samplers that will be incorporated into the existing air monitoring program for the duration of the lined pond closure activities.

5.2.5. Waste Management

During normal operations of the facility, effluents and wastes are minimized to the extent reasonably achievable through the use of process and engineering controls. This goal will continue through the pond closure phase as well as described below.

5.2.5.1 Gaseous Effluents

Emissions will be controlled to the extent practicable by maintaining and handling the waste materials in a form that minimizes the potential for airborne emissions. Although the high moisture level in the pond sediment material will act to minimize the likelihood of dusting to occur, dust control practices will be used throughout the project, when needed.

The existing environmental air monitoring network, consisting of five (5) ambient air monitoring stations, will remain in operation during pond closure activities. As described above, the environmental monitoring program will be slightly expanded to ensure that data is obtained from the closure activities occurring at the lined ponds. This expansion will consist of installation and operation of two (2) continuous operating particulate air monitoring samplers that will be incorporated into the existing air monitoring program for the duration of the lined pond closure activities.

5.2.5.2 Liquid Effluents

A decontamination area will be established to allow for equipment washing prior to unrestricted release. The size of the equipment requiring decontamination and/or weather constraints will dictate which wash facility is used. All wash water will be collected and disposed within lined evaporation cells. Sanitary (domestic) wastes will be kept segregated from all other liquid wastes.

5.2.5.3 Solid Wastes

Solid waste generated during pond closure activities will consist of two types: uncontaminated and contaminated. By definition (AEA, 1954, as amended), all wastes contained within the evaporation pond system are classified as 11e.(2) byproduct material.

Uncontaminated Waste

Uncontaminated wastes generated during pond closure activities will consist of materials such as trash, papers, and various other similar materials. This general waste, which is expected to be generated from offices, lunchrooms and shops, will be disposed of within a Company landfill in accordance with New Mexico Solid Waste Regulations or be collected and transported to the regional landfill.

Contaminated Waste

Disposal of all waste that is classified as 11e.(2) byproduct material, as defined by the AEA of 1954, as amended, shall be performed in accordance with approved disposal practices as authorized by License Conditions #30, 32, 36, and 41. Sources of contaminated wastes are anticipated to include pond sediment material, pond liners and pipelines, and contaminated protective clothing (e.g., Tyvek, gloves, etc.)

5.2.6 Quality Assurance

Rio Algom shall continue to implement the existing radiation safety program quality assurance plan during lined pond closure activities as outlined within the Health Physics and Environmental Programs Manual as authorized by License Condition 10. This plan addresses the use of approved procedures for performing health physics and environmental monitoring activities, review and analysis of data, instrument calibration requirements, the use of vendors for services, and performance of periodic program audits. The existing procedures are included within Section 2 of the Health Physics and Environmental Programs Manual (Appendix G-1).

Additionally, Rio Algom will continue to implement the Health, Environment, Safety and Community management system to ensure that all activities are evaluated and performed in a responsible manner to ensure protection of employees and workers, the public, and the environment.

6.0 RECLAMATION COSTS

6.1. INTRODUCTION

The following presents the reclamation costs associated with implementing the designed reclamation plan for the Section 4 and Pond 9 lined evaporation ponds. The work elements and costs identified below do not include the closure costs associated with construction of the disposal cell at Pond 2.

The costs developed for the decommissioning are based upon Third Party contractor bids. These bids were received from ten potential contractors, and from those bids, the best two bids for the entire scope of work were used as the basis of decommissioning cost estimate. The reclamation costs presented within this section are based on "Contractor" unit prices in current dollars (2004 dollars).

The purpose for including this cost estimate is to provide a basis for establishing an appropriate surety for the performance of this reclamation plan. This cost estimation accordingly includes all items relative to conducting and completing the reclamation plan including labor, equipment, and material costs, overhead, profit, contingency, royalties and taxes. These costs are discussed in the following sub-sections.

6.2. SCOPE OF WORK

The Scope of Work for the relocation of lined pond sediments and associated materials includes the following general work areas:

- <u>Mobilization</u> - relocation of contractor's equipment, manpower, and training. It also includes setup of equipment maintenance areas, staging areas, and infrastructure, (e.g. haul roads, etc.).
- <u>Road Crossing Construction</u> - the material removed from the Section 4 lined pond area will be relocated by truck haul to the Pond 2 site. This

truck haul requires that to get to the disposal area on Pond 2, the traffic must cross New Mexico State Highway 509 (Hwy 509). A risk assessment was performed on this crossing, and given the volume of traffic, an overpass of the highway will be constructed. These costs are based on third party contract estimates to construct the crossing to the specifications of the New Mexico Department of Transportation. The NMDOT has approved a categorical exclusion assessment for construction of the crossing.

- Sediment/Berm Removal - this work area provides the most significant effort. The pond sludge, sediments, debris, liners and other associated materials will be mixed with contaminated soils from the pond berms and base to a consistency that allows for transport to Pond 2 with no free liquids. That material will be placed on Pond 2 and amended with additional contaminated soils or borrow soils that will allow for a six-inch lift to be compacted to 90 percent standard proctor density. Estimated volume: 1,966,000 cy.

- Pipeline Removal – this work involves the excavation, removal, transport and disposal of 8,150 linear feet of the solution transfer line from Pond 9 to section 4. Materials will be transported and disposed in the Pond 2 area or within the cell designated for contaminated mill equipment.

- Re-contouring and Revegetation - this work area includes the re-grading and revegetation of the former pond areas in Section 4, additional infrastructure, (e.g. haul roads, staging areas, and etc.), and borrow areas. Recontouring and revegetation of Pond 9 will be done under existing Rio Algom contracts.

- Site Management and HP Support - this work area includes the expected cost for management oversight of the relocation activities. Additionally, the material handled during the relocation effort will possess some low-level radioactivity, and the work will be performed under the existing site health physics protection program. The costs associated with this portion of this work area include personnel monitoring and HP staff.

6.3. *COST ESTIMATE*

The cost estimate found in Table 6-1 follows the Scope of Work provided above. The basis for the cost estimate results from third party contractor bids provided to Rio Algom Mining LLC. This cost estimate has been provided in the 2004 Surety Update for the Ambrosia Lake Facility submitted to NRC on June 30, 2004.

Table 6-1
Cost Estimate for the Decommissioning of the Lined Evaporation Ponds

Work Area	Estimated Cost	Basis
1. Mobilization	$1,000,000	3rd Party Contractor Bid
2. Road Crossing Construction	$403,000	3rd Party Contractor Bid
3. Sediment/Berm Removal (Section 4)	$7,500,000	3rd Party Contractor Bid
4. Re-contouring and Revegetation (Section 4)	$230,000	3rd Party Contractor Bid
5. Pipeline Removal	$6,800	3rd Party Contractor Bid
Total Costs:	**9,201,000**	

Table 6-1 notes:

1. Listed costs are 3rd party contract prices (see attached contract documents)
2. Costs associated with final site survey activities not included
3. Costs do not include site management, overhead and profit, contingency, and LTSM costs

7.0 REFERENCES

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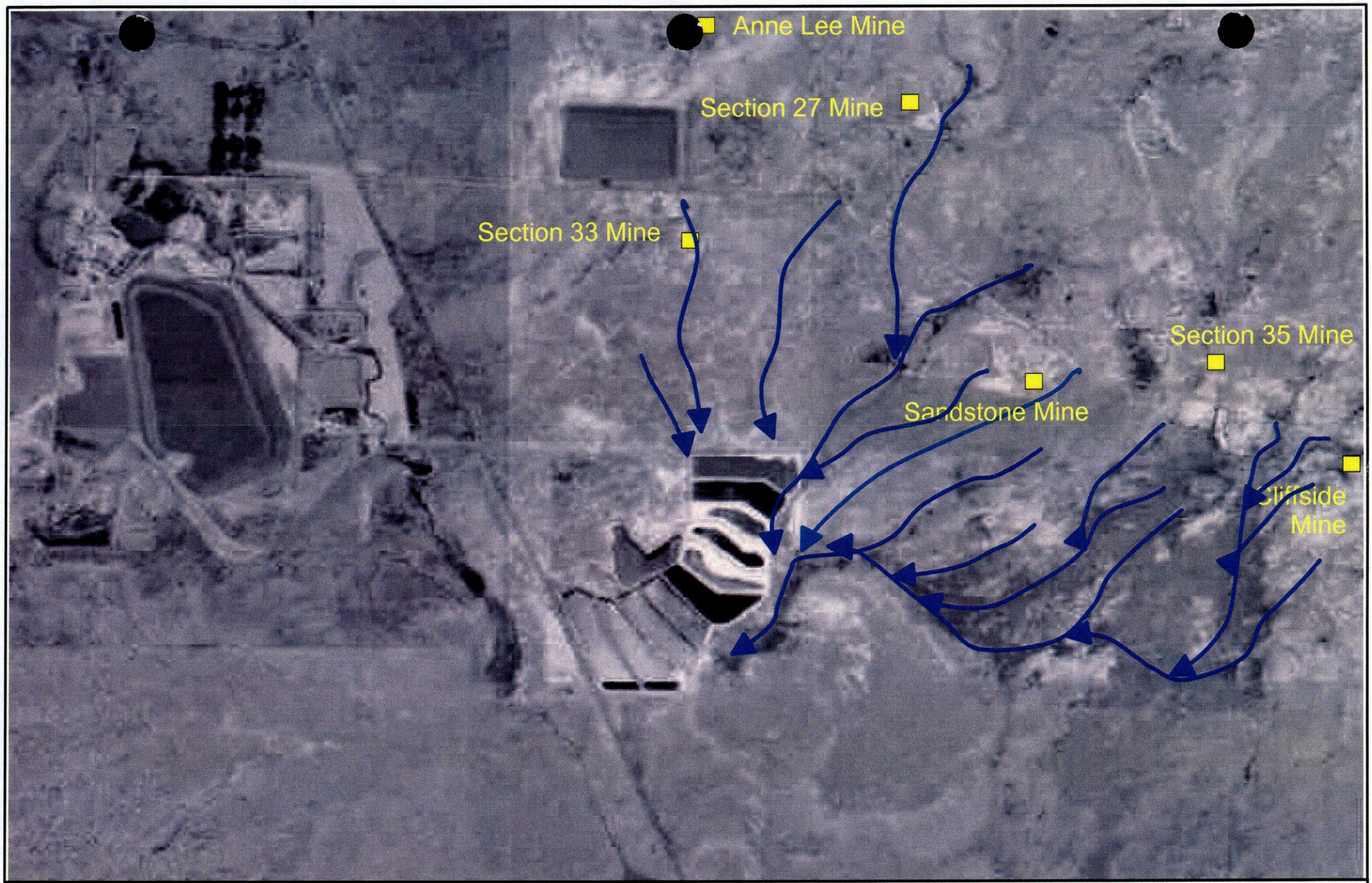

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Figure 2-3. Mine Discharge Channels (Blue Arrows)

Project No. 4690029	Drawing By: AEA	Date: 01.27.05	Rio Algom
File Name: Ambrosia Map.dsf	Checked By: DWE	Date: 01.27.05	Ambrosia Lake, New Mexico