Rio Algom

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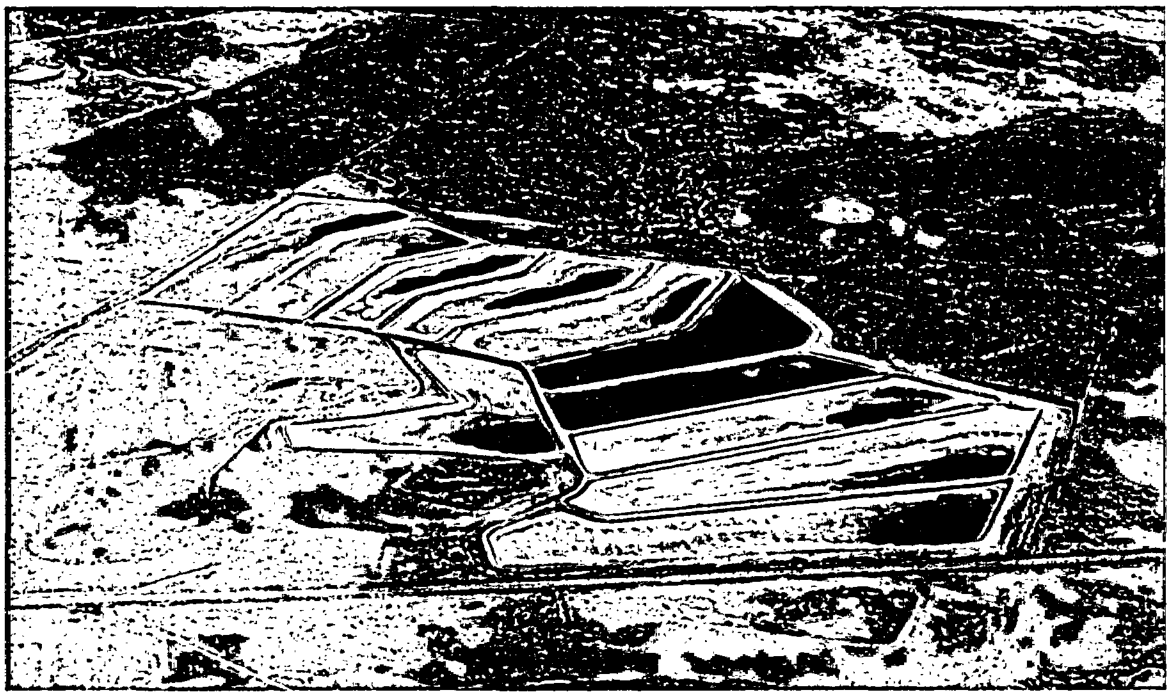
RIO ALGOM MINING LLC
AMBROSIA LAKE, NEW MEXICO



CLOSURE PLAN
LINED EVAPORATION PONDS

NRC License #SUA-1473
Docket #40-8905

OCTOBER 2004

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Prepared for:
Rio Algom Mining LLC.

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OCTOBER 2004

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1.0 INTRODUCTION

1.1. PURPOSE

The purpose of this closure plan is to provide support and documentation to assure that the plan design and implementation meets the requirements established by the Uranium Mill Tailings Radiation Control Act of 1978, (UMTRCA) as amended, pursuant to regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) regulations contained within Title 10, Part 40, Appendix A.

This plan presents the geographical site, pertinent background information and the design for surface reclamation of the "Section 4" and Pond 9 evaporation pond sediment material that is considered "byproduct" material as defined by the Atomic Energy Act of 1954, as amended. Description of the final disposal and stabilization of the materials associated with the evaporation ponds to be excavated and relocated will be transmitted as a separate design document for review and approval.

1.2. SCOPE

This document contains information relative to the closure plan describing the decommissioning of byproduct material 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 Reclamation of the Section 4 ponds and Pond 9, providing the approach and rationale for cleanup;
- Section 5 – Surface Reclamation Verification, describes the methods and procedures to demonstrate reclamation activities were successful in achieving site restoration with respect to applicable release criteria;
- Section 6 – 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 7 – Cost, presents the contractor costs to implement the surface reclamation project.

1.3. GENERAL SETTING

The lined evaporation ponds, which are part of the Rio Algom uranium milling operations, are located in the heart of 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 on Section 4, Township 13 North, Range 9 West; hence, their description 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 evaporation 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 6 to 10 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 9 inches, while annual pan evaporation ranges from 46 inches to 72 inches per year (Stone et al., 1983). Primarily, moisture comes 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 only occurred 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 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 1 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 small community of San Mateo (100 residents) located approximately 9 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 facilties 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 revisions to the proposed work elements, will be undertaken, if warranted.

The proposed 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 sparce evidence of cultural and historic artifacts. Isolated occurrences of ceramic pottery shards were observed in the proposed haul road location 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 Formation, the Dakota Sandstone, and the Brushy Basin and the Westwater Canyon members of the Morrison Formation. The Mancos, generally considered to be an aquiclude, is approximately 250 feet thick in the Ambrosia Lake Valley area. 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 the primary water-bearing unit in the region. All units dip approximately 3 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% with chalcedony typically present near 24% by volume. Limonite and calcite each typically exceed 10% of the sample. Gypsum constitutes approximately 1% to 2% 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 regulated 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 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. A separation of constituents of concern occurs during the 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

Rio Algom performed a preliminary characterization study at the lined Section 4 Ponds including surface gamma radiation surveys and soil sampling in drainages and adjacent areas. Results of gamma surveys (Figure 2-7) 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 traced back to the mining features as seen in Figure 2-7.

Laboratory analyses of soil samples from study locations depicted in Figure 2-8 are consistent with the results of the gamma survey. 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. Data shows that Ra-226 is elevated in the drainage channel areas originating from north and east of the Section 4 Ponds. These data demonstrate that the overwhelming majority of radionuclides mass in soils in the vicinity of the Section 4 Ponds is the product of mine drainage flow. Thus, 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 sediments 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.

Therefore, in an effort to facilitate closure activites and be responsible stewards for milling waste, 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.
- Monitor wells located outside of the Section 4 Pond footprint that will not impede in the closure activities from proceeding in a safe and efficient manner will remain intact during closure activities in order to monitor whether any impacts are occurring as a result of the reclamation 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% 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 twelve (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.

Pond 9 was constructed adjacent to pond 3 at the mill site in alluvial soils. The bottom lined with10 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 from 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). 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 and 4-2, respectively, with the commercial laboratory analytical results contained in Appendix E.

TABLE 4-1. RADIUM 226 CONCENTRATIONS

Location	Date	Ra-226 (pCi/gram)	Location	Date	Ra-226 (pCi/gram)
Pond 9 (NW)	October 31, 2003	80.2	Pond 9 (SW)	October 31, 2003	71.5
Pond 11	April 25, 2003	41.0	Pond 17	April 25, 2003	60.6
Pond 12 (0-6")	May 27, 1988	7.4	Pond 18	April 25, 2003	63.5
Pond 12 (6-12')	May 27, 1988	34.0	Pond 19 (0-6")	May 27, 1988	28.0
Pond 12	April 25, 2003	43.8	Pond 19 (6-12")	May 27, 1988	7.4
Pond 13	April 25, 2003	36.7	Pond 19	April 25, 2003	26.7
Pond 14	April 25, 2003	14.8	Pond 20 (0-6")	May 27, 1988	28.0
Pond 15	April 25, 2003	23.4	Pond 20 (6-12")	May 27, 1988	26.0
Pond 16 (0-6")	May 27, 1988	26.0	Pond 21	April 25, 2003	33.6
Pond 16	April 25, 2003	31.3	**Average**	---	**36.0**

TABLE 4-2. THORIUM 230 CONCENTRATIONS

Location	Date	Th-230 (pCi/gram)	Location	Date	Th-230 (pCi/gram)
Pond 9 (NW)	October 31, 2003	175	Pond 9 (SW)	October 31, 2003	269
Pond 9 (NW) (Rerun)	October 31, 2003	343	Pond 9 (SW) (Rerun)	October 31, 2003	592
Pond 9 (NW) (Rerun)	October 31, 2003	718	Pond 17 (1.5-12")	May 22, 1990	750
Pond 11	April 25, 2003	555.0	Pond 17	April 25, 2003	148
Pond 12	April 25, 2003	720.0	Pond 18	April 25, 2003	840
Pond 13	April 25, 2003	896	Pond 19 (0-1.5")	May 22, 1990	490
Pond 14	April 25, 2003	1130	Pond 19 (1.5-12")	May 22, 1990	810
Pond 15	April 25, 2003	520	Pond 19	April 25, 2003	713
Pond 15 (0-1.5")	May 22, 1990	640	Pond 20 (0-1.5")	May 22, 1990	1810
Pond 15 (1.5-12")	May 22, 1990	1000	Pond 20 (1.5-12")	May 22, 1990	2030
Pond 16	April 25, 2003	365	Pond 21	April 25, 2003	1050
Pond 17 (0-1.5")	May 22, 1990	310	**Average**	---	**780.9**

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 4-3 and Figure 4-2.

TABLE 4-3. 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 6 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 6 inch soil layer beneath the bottom liners of ponds. Excavation will include the 6-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 yards3 and is summarized in Table 4-4.

TABLE 4-4. 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 with the objective of releasing the Section 4 Pond area in accordance with Title 10 CFR Part 40, Appendix A, criterion 6. In addition, excavation control will minimize the amount of material that will be excavated while meeting the standards.

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, characterization of the soils below the pond liners will commence through a combination of visual observation, radiation surveying, and direct soil sampling. Areas where moisture is present in the soils may be an indication of pond impacts. Direct radiation survey techniques will be used where measurements are not seriously impaired by interference from soils impacted from historic mine drainage not related to the pond operations.

In areas where significant interference exists, soil samples will be collected and analyzed for radionuclides of interest with the results evaluated to ascertain the source of the residual radioactive material. All material whose concentrations are below the established area background and soils characterized by historic mine drainage impacts will not be removed.

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 ion exchange, these untreated waters were discharged directly to the surface drainages. Soils below the ponds 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 will utilize this technique to differentiate between residual radionuclides associated with byproduct material from those attributable to mine activities.

In all cases, delineation and excavation of radionuclide impacted soils will follow the protocols as described in the Rio Algom Mining Company, Ambrosia Lake Contaminated Soil Cleanup Plan, October, 2000. This document is currently in final revision per NRC's Request for Additional Information and is expected to be re-submitted in late 2004. Included in this document will be a background assessment for mill and tailings areas and gamma guidelines for differentiation of radionuclide sources.

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 using approximately half of the estimated 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).

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 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 with the requirements specified within Title 10 CFR Part 40, Appendix A, criterion 6.

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 December 2004. 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 placed 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 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 compaction, 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 outlined in Section 6, 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 1 percent but in the transition areas between the former pond areas the slopes will range from 2 to 5 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 2 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 US 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 1 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 3 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 RECLAMATION VERIFICATION

5.1. *OVERVIEW*

This section describes the activities for reclamation of soils impacted by licensed activities, and the methods that will be used to demonstrate success in reclaiming the impacted soils with respect to applicable release criteria. This Plan has been prepared in accordance with NUREG-1620 (NRC,2003), and primarily covers verification of Section 4 Ponds cleanup. Excavation of radionuclide impacted soils in the area of Pond 9 will follow protocols as described in the *Rio Algom Mining Company, Ambrosia Lake Contaminated Soil Cleanup Plan, October, 2000* (in revision). Geographic areas covered by the provisions of this Plan include:

- Areas of surface soil impacted by windblown pond sediments. These areas are located downwind, toward the east and northeast.
- Areas of possible deep soil impacts. These areas include the footprints of the Ponds. These areas are covered by the basic provisions and methods outlined in this Plan, but clean up levels and compliance criteria will not be finalized until further soil characterization can be completed.

Geographic areas *not* covered by the provisions of this Plan include the following:

- Unaffected areas not impacted by windblown sediments, process solutions, or mining activities (pristine areas). Unaffected areas are located upwind of the Ponds, or beyond the area of influence of windblown materials.
- Areas of surface soil contamination affected by mining activities. Mining operations have impacted significant areas surrounding the Ponds.

- Areas of possible deep soil contamination impacted by mining operations. These areas include surface drainages that have received mine water discharge.

Radiation surveys, sampling, analysis and data management will be performed by qualified personnel currently employed by RAM or by qualified consulting firms and contract laboratories with well recognized analytical capabilities. This program operates under the direction of the site Radiation Safety Officer (RSO). The RSO will have the authority to revise field survey plans as necessary as work progresses. Field radiation measurements and/or sampling will be performed by trained RAM personnel or contracted to a consulting firm experienced in radiation surveys and sampling techniques.

Excavation work will be performed under the direction of the facility General Manager. The RSO will coordinate with the General Manager on any excavation work that would be required. Quality Control and Assurance responsibilities will rest with the Manager of Radiation Safety and Environmental Affairs. Records associated with the Soil Decommissioning Plan are located at the Rio Algom Mining LLC Ambrosia Lake Facility.

5.2. SOIL BACKGROUND EVALUATION

5.2.1. Radionuclides of Concern

The principal radionuclide constituents or Radionuclides of Concern (RoCs) are associated with the uranium transformation series and are natural uranium, thorium-230, and radium-226. The RoCs are present in the surrounding area as a result of the extensive uranium mining activities that occurred adjacent to the Rio Algom facility.

Results of soil sampling collected in the vicinity of the Section 4 ponds are shown in Figures 2-7 and 2-8. The data indicate that areas where uranium and Ra-226 concentrations are elevated are in the mine water drainage channel originating from north and east of the Section 4 ponds (see discussion in Section 2.3.1). This is consistent with the condition that mine waters were typically elevated in both uranium and Ra-226.

The Section 4 ponds contained the liquid effluent from the acid leach of the uranium ore. This effluent typically contained high concentrations of Th-230. The Th-230 concentrations in soil are generally elevated immediately adjacent to the Section 4 ponds. This condition indicates that only a small area has been affected by windblown material from the material stored in the Section 4 ponds. Results of a recent gamma survey of the affected area are shown in Figure 2-7. The probable source of the impacts can be attributed to licensed activities or non-licensed activities through evaluation of characteristics unique to the source, including element ratios. This condition will be explored further during development of background radioactivity concentrations.

Areas that are not expected to contain radioactive impacts attributable to licensed activities and that have not been impacted mining activities will be classified as unaffected areas. Unaffected areas are located generally upwind or cross-gradient of the site and possess background concentrations of RoCs and gamma radiation levels.

5.2.2. Soil Background Radioactivity

Background soil concentrations will be developed for natural background conditions at the site as well as for mining-affected background conditions. Based on the evaluation of the existing background data and NRC guidance (NRC, 2003) recommending that background soil samples be collected within two miles of the site, the following areas are considered for collection of background soil samples:

- The northern half of Section 25 and the southern half of Section 24, located northwest of the site. This area is approximately side-gradient of the prevailing wind direction and is far enough from the site (approximately 0.5 to 1.5 miles) to preclude impacts from windblown tailings.

- The southern half of Sections 19 and 20, located north of the site. These areas are generally side-gradient of the prevailing wind direction and far enough from the site (1 mile or more) to make windblown tailings impacts unlikely.

- The eastern quarter of Section 32 and the western half of Section 33. This area is outside the windblown-tailings-affected area based on the results of gamma survey measurements.

In addition to the collection of soil samples for determination of radium-226, thorium-230 and uranium (nat), gamma measurements will be collected at the same locations to help establish background gamma levels and to assist in the development of a gamma/radium-226 concentration correlation. At least 20 locations will be selected for sample collection to provide characterization of natural background soil concentrations.

Two sets of samples will be collected to determine mining-affected background concentrations and the possible impacts of windblown tailings on mining-affected areas:

- Mining-affected locations outside the areas of potential influence of windblown tailings from the Ambrosia Lake site. These locations should be within two miles of the site and located either north or west of the tailings impoundment (e.g., United Western Mine).
- Mining-affected locations within the possible area of influence of windblown tailings, which would consist of the western portion of the Homestake New Mexico Partners Mine and areas near the Ambrosia Lake site that have been affected by drainage from the mine.

Approximately 30 samples will be collected from each type of area, and gamma measurements will be collected at the time of soil sampling to document the range of gamma readings that are characteristic of these areas. Comparison of the analytical results from the two groups of mining-affected soil samples will indicate whether windblown tailings have had significant effects on the soil concentrations of radium-226, thorium-230, or uranium (nat) in areas northeast of the tailings impoundment, or whether the effects (if any) are indistinguishable from the effects of uranium mining.

5.2.3. Background Data Evaluation

These radioactivity concentration data of the background soil samples will be evaluated using probability-distribution diagrams to identify distinct data populations. The identification of different populations will be facilitated, the possibility of bias in assigning the data to different populations is minimized, and the maximum number of locations that can be defensibly included in the background data set will be identified. The characteristics of the soil data populations, the geographic locations of samples within each population, and knowledge of site conditions, including operations history, geology, and prevailing wind conditions, will be used to identify the soil populations consistent with either background or windblown-tailings or mining affected soils.

Individual samples within the apparent background populations will be evaluated to conservatively identify natural and mining-affected background locations. Field observations obtained at the sampling locations will be considered in addition to analytical results and geographic location when determining whether an individual sample should be included in the natural and mining-affected background data sets.

After the data sets and populations have been identified for the natural background and mining-affected background sample locations, the data will be evaluated to determine whether it is normally or log-normally distributed. If the data appear to be log-normally distributed, three methods will be used to demonstrate the log-normal data distribution, in accordance with NRC guidance (NRC, 2003). Summary statistics will be calculated for the data, including the mean, median, standard deviation, and confidence intervals. The arithmetic mean and other statistics will be calculated for all identified natural background and mining-affected soil data. If the data are demonstrated to have a log-normal distribution, log-normal statistics will be calculated. The summary statistics will be evaluated and the appropriate summary statistic will be selected for each background concentration. Because the background concentration should reflect not only the mean or median value, but also the inherent variability of the background values, we expect that an upper confidence level will be the appropriate parameter for characterizing background concentrations.

The mining-affected sample data will be evaluated to determine if samples from mining-affected areas that have been potentially impacted by windblown tailings are statistically different from samples from mining-affected areas outside the windblown-tailings-affected areas. If the effects of windblown tailings cannot be distinguished from the effects of uranium mining, these areas will be identified as mining-affected background and removed from further consideration.

5.2.4. Benchmark Dose

A benchmark dose will be developed for the site. The benchmark dose will be developed for radium-226 in surface soils in accordance with NRC guidance (NRC, 2003). The dose will be calculated using version 6.21 of the RESRAD dose modeling software.

A rancher exposure scenario will be chosen for the site. The scenario and associated exposure pathways will be established primarily from NUREG-1620, Appendix H, and SECY 98-046, Attachment 3, Section 4 and Table 2. Values for exposure pathway parameters will be chosen from either NUREG-1620, Appendix H; SECY 98-046, Attachment 3, Section 5 and Table 1; site specific or local information; or estimates from applicable or relevant guidance. A justification for choice of each parameter value will be included with the description of the benchmark dose.

A sensitivity analysis will be completed for the benchmark dose. The sensitivity analysis will be included with the description of the benchmark dose.

5.3. *SOIL CLEANUP REQUIREMENTS*

Criterion 6 of Appendix A of 10 CFR 40 sets concentration limits for radium-226 in soil at 5 pCi/g in the top six inches. The criterion also specifies that concentrations of radionuclides other than radium-226 in soil must not result in a Total Effective Dose Equivalent (TEDE) that exceeds the dose from radium-226-contaminated soil at specific concentration limits. This dose from Ra-226 is referred to as the radium benchmark dose. The criterion further specifies that if more than one residual radionuclide is present, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed unity.

NRC guidance (NRC, 2003) recognizes two different approaches to application of the radium benchmark dose. The first approach is to use the radium benchmark dose to derive soil concentration limits and, as discussed later in the guidance, apply the unity rule to determine compliance at the site. This approach is the direct method of compliance with Criterion 6.

The second approach is to model the current or planned future conditions at the site, calculate the dose from the residual contamination, and compare the results to the radium benchmark dose in order to demonstrate compliance. This approach incorporates the unity rule inherently as it limits the peak dose to the radium benchmark dose. This approach may allow higher initial total uranium, thorium-230, or radium-226 concentrations than the concentration limit approach. This approach is an indirect method of compliance with Criterion 6.

5.3.1. Surface Soils

Surface soil concentration limits (SCL) will be developed from the radium benchmark dose for total uranium and thorium-230 in accordance with NRC guidance (NRC, 2003). The exposure scenario and associated inputs and model described for the radium benchmark dose will be applied independently to concentrations of total uranium in soil and thorium-230 in soil. The radionuclide concentrations in soil for total uranium and thorium-230 that result in a dose equivalent to the benchmark dose will be determined, respectively.

In areas where uranium and thorium are not present, the radium-226 SCL will be used. In areas where uranium and thorium-230 are present, the SCLs will be considered in combination to ensure that the applicable dose limit is met, i.e. the sum of ratios of radionuclide concentration to respective SCL will not exceed one.

5.3.1.1. Deep Impacts

Alternate Release Criteria (ARC) will be used to demonstrate compliance with the regulatory criteria for areas of deep impacts. A dose assessment will be completed for the area of the Ponds. The dose assessment will be centered on the rancher scenario used to establish the radium benchmark dose. The exposure pathway modeling will be a deterministic analysis of the peak annual dose to the average member of the critical group for a rancher exposure scenario. The dose assessment will account for site-specific information regarding the source term; critical group, scenario, and pathways identification and selection; the conceptual model; and calculations and input parameters.

The dose assessment will be developed in particular for the case of license termination. The dose assessment will be developed without consideration of any institutional controls and such that there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as is reasonably achievable.

The dose assessment will be completed solely with respect to dose received due to pathways related to residual radioactive material in subsurface soil. Several pathways are anticipated to not be included in the dose assessment because they are not applicable; e.g. drinking water. The results of the dose assessment will be will be compared to the radium benchmark dose to evaluate status of compliance.

5.3.1.2. Gamma Guideline Value

A correlation between gamma measurements and radium-226 concentrations may be developed to identify areas requiring clean up during the Final Status Survey at the Ponds. Data used in the correlation will be collected in areas representative of areas believed to be affected by windblown 11e.(2) material near the site. Areas affected by non-11e.(2) uranium mining waste and drainage will not be included in the gamma correlation.

The samples will be collected and analyzed using the procedures planned for the final status survey. At least 30 samples will be included in the correlation development. A linear regression will be completed on the data.

The SCL for radium-226 of 5 pCi/g and the site background concentration will be summed to determine a total soil clean up concentration. The gamma reading at which this radium-226 concentration intersects the lower confidence level of the gamma-radium-226 correlation will be selected as the gamma guideline level. This intersection of the radium-226 concentration with the lower confidence level conservatively establishes a low gamma guideline value.

5.4. RECLAMATION STRATEGY

The Reclamation strategy for an area at the site is dependent on the applicable soil clean up requirements; i.e. surface soils or areas of deeper impacts. The Reclamation strategy for surface soils includes two techniques: removing the contaminated soil or reducing the concentration of radionuclides in the contaminated soil by mixing. The reclamation strategy for areas of deeper impacts could be to provide a physical cover for the area.

5.4.1. Surface Soils

Two techniques will be considered for reclamation of surface soils: excavation and mixing. The two techniques are expected to be applied independently; i.e. they are not anticipated to be used together.

5.4.1.1. Excavation

Excavation will consist of picking up contaminated soil and transporting it to the disposal cell. Excavation is expected to be limited to the top six inches of surface soil.

Excavation techniques for larger areas will include grading and/or scraping. The contaminated area may be graded to form windrows of surface soil which are subsequently picked up by scraper. Otherwise, the surface soil may be picked up directly by scraper. The excavated area will be contoured by grading as necessary after excavation to facilitate survey activities.

Excavation techniques for small areas will include grading and/or scraping. The surface soil of the contaminated area may be pushed into a pile which is subsequently picked up by bucket loader. Otherwise, the surface soil may be picked up directly by bucket loader. The excavated area will be contoured by grading or backfill with clean soil as necessary after excavation and successful surveys.

Pipelines that were used for transferring waste solutions will be excavated, surveyed to determine compliance with the clean-up criteria and backfilled in order to eliminate potential safety hazards.

5.4.1.2. Soil Mixing

Soil mixing will be considered for areas where removal of contaminated soil is not reasonably achievable or would cause excessive risk to the safety of workers and/or citizens. Consideration will account for potential cost savings that could be a benefit, consistent with protection of the public health and safety and the environment.

Soil mixing will consist of intentional mixing of contaminated soil with underlying cleaner soil. Soil mixing is expected to be limited to the top six inches of surface soil.

The resultant footprint of the area containing the contaminated soil after soil mixing will not be greater than the original footprint of the area containing the contaminated soil attributable to licensed activities. Also, clean soil from outside the footprint of the area containing the contaminated soil will not be mixed with contaminated soil to lower concentrations.

Soil mixing techniques will be comparable to standard agricultural practices; e.g. disc or plow and/or harrow. The resultant area may be contoured by grading in order to facilitate final surveying.

5.4.2. Deep Impacts

Reclamation of soils in areas of deep impacts will be accomplished by grading and covering. The area will be prepared by grading to provide a consistent base and uniform contours. Subsequently, no less than one foot of clean soil cover will be placed onto the area and contoured. The grading and placement of cover will be completed using standard construction equipment and practices.

5.5. FINAL STATUS SURVEY PLAN

This section describes the plan for conducting the Final Status Survey (FSS) at the site. The objective of the final status survey plan described here is to demonstrate that the final condition of the site satisfies the requirements of 10 CFR 40 Appendix A.

5.5.1. Surface Soil

The objective of the final status survey plan described here is to demonstrate that the final condition of the site satisfies the requirements of 10 CFR 40 Appendix A Criterion 6(6). The scope of the final status survey plan for surface soil is limited to those soils impacted at the surface by windblown material.

The radionuclides of concern in the surface soils are identified previously as natural uranium, thorium-230, and radium-226. Determination of SCLs is described previously. The applicable soil clean-up levels will determined by adding respective background concentrations to the SCLs.

Instruments and procedures used to generate data during the surveys can be placed into two categories commonly known as scanning surveys and soil sampling. These survey techniques will be combined in an integrated survey design.

- Scanning Surveys: Land areas will be scanned for gross gamma radiations. The type of instrument used for scanning and typical performance characteristics are provided in Table 5-1.
- Soil Sampling: Samples of soil will be collected and analyzed for the radionuclides of concern. The analysis technique and typical detection limit for each radionuclide of concern is provided in Table 5-2.

Table 5-1. Identification Of Radiation Detection Instruments For The Final Status Survey

Measurement	Instrumentation Detector Meter		Background[a] (cpm)	Detection Sensitivity
Scanning Survey	2" x 2" NaI(Tl) Ludlum Meas., Inc., Model 44-10	Scaler/ratemeter, Ludlum Meas., Inc., Model 2221.	18000	18,600 cpm[b], 1.8 pCi/g, as Ra-226

Table 5-2. Identification Of Radioanalytical Methods For Final Status Survey

Constituent Of Concern	Analytical Method	Detection Limit[a], (pCi/g)
Total Uranium	gamma spectrometry via Th-234 and Pa-234m (Total uranium activity will be determined from U-238 activity by assuming activity ratios of U-238/U-235/U-234 = 0.489 /0.022 /0.489.)	15
Thorium-230	alpha spectrometry	1
Radium-226	gamma spectrometry via in-growth of radon	0.5
[a] Maximum values		

Instrumentation utilized for scanning and measurements will be calibrated and maintained in accordance with written procedures. These procedures utilize the manufacturers' guidance. Portable instruments are calibrated on an annual frequency or as required due to maintenance.

Specific requirements for instrumentation include traceability to NIST standards, daily checks for operability, daily performance checks of background and source, operation of instruments within established environmental bounds (e.g. temperature), training of individuals, calibration with radiations of energies similar to those to be measured, quality assurance tests, data review, and recordkeeping. Where applicable, activities of sources utilized for calibration are also corrected for decay. All calibration and source check records are completed, reviewed, and retained in accordance with quality assurance requirements.

RAM will conduct survey activities and tasks in accordance with approved written procedures. The written procedures have been or will be prepared, reviewed, revised, approved and implemented in accordance with the facility source material license.

5.5.1.1. Scanning Surveys

The scanning survey will be completed using a NaI(Tl) radiation detector coupled to a handheld scaler/ratemeter. Measurements will be collected by keeping the detector approximately 18 inches above the ground surface while walking or driving over the area at a rate comparable to a casual walk. The measurements will be made along straight line paths between opposite borders of the area being surveyed. The distance between the paths will be approximately six feet.

The scaler/ratemeter will be coupled to global positioning system (GPS) equipment and a data logger. A gamma measurement from the scaler/ratemeter and a location from the GPS will be recorded approximately every two seconds.

The gamma measurement will be recorded as counts per minute. The location will be recorded with respect to the reference coordinate system described later.

5.5.1.2. Soil Sampling

Soil samples will be collected in a known and consistent fashion, and with respect to the location reference system used for the scanning survey. Soil plugs will be collected from five evenly spaced locations across a 100m^2 block. The soil plugs will be collected from the top six inches of soil. The five plugs from a six inch layer will be combined to create one composite soil sample.

Sample collection activities will also include documentation of sampling activities on a field log, decontamination of equipment between sample locations, and collection of replicate samples at a rate of one per 10. Chain-of-custody procedures will be applied beginning at the time of sample collection.

The composite soil samples will be prepared in a known and consistent manner for laboratory analysis. The preparation will include removing rocks and vegetation, drying (if needed), crushing, and mixing/blending. The preparation concludes with placement of the prepared soil in a container and labeling the container. Sample preparation will include splitting the sample as necessary to support analysis by radiochemistry and/or gamma spectrometry.

Sample preparation will also include documentation of preparation activities in a laboratory log, decontamination of equipment between samples, and creation of duplicate samples at a rate of one per 10. Chain-of-custody will be maintained during sample preparation.

The prepared samples will be stored indoors. The manner of storage will include an inventory system and access to allow convenient retrieval according to the sample's unique identification. Chain-of-custody will be maintained during sample storage.

Prepared samples requiring analysis for the RoCs will be shipped to an offsite laboratory. Chain-of-custody will be maintained during sample analysis. Upon termination of reclamation activities, stored samples will be disposed.

5.5.1.3 Data Assessment

A reference coordinate system will be used to facilitate identification of measurement and sampling locations, and to provide a mechanism for relocating a survey point. Land area scanning surveys and soil sample locations will be referenced to the New Mexico State Plane (NAD 27 horizontal). The site specific background concentrations in soil for the RoCs will be determined as described previously.

A scanning survey will be completed for essentially all of the windblown area. The scanning survey data will be comprised of historical survey data and scanning survey data collected following reclamation of contaminated areas.

Soil sampling will be completed for two percent of the 100 m^2 blocks comprising the windblown area. The locations of the soil samples will be chosen from areas where the scanning survey results are nearest the gamma guideline value. Areas of higher scanning survey results will be considered preferentially.

The soil sample collection and preparation procedures described previously will increase the total number of samples collected by the number of sample replicates and sample duplicates. Results of characterization sampling and reclamation control sampling of soils may be incorporated into to the final status survey data set.

The instrumentation and procedures used in the FSS are the same as those utilized in the development of soil background concentrations and the gamma guideline value.

The scanning measurements will be averaged for each 100 m^2 block. Additionally, the number of individual survey readings in each grid will be determined. Grids not meeting the scanning density (10 readings per grid), will be flagged for additional surveys. The scanning average value will be compared directly to the gamma guideline value. If the scanning average value is less than or equal to the gamma guideline value, no further measurement or evaluation will be made of the 100 m^2 block. If the scanning average value is greater than the gamma guideline value, reclamation or soil sampling will be completed of the 100 m^2 block, followed by resurvey.

If a soil sample is collected, the soil sample result will be compared to clean up levels such that the sum of the ratios for the concentration of each RoC to the respective SCL will not exceed "1" (unity). If the sum of ratios is less than or equal to one, no further measurement or evaluation will be made of the 100 m^2 block. If the sum of the ratios exceeds unity, the block and every adjacent block will be remediated and re-surveyed.

A tabular and graphic record will be compiled describing the scanning survey results relative to the gamma guideline value, reclamation and subsequent scanning survey, and soil sample results.

If the number of failed 100 m^2 blocks is greater than five in 100 (i.e. the number of failed 100 m^2 blocks is excessive), the gamma guideline value will be re-evaluated and adjusted downward.

5.5.2. Deep Impacts

Seepage from the Ponds may have resulted in deep soil impacts. These areas are targeted for cover placement and release without further clean up by application of ARC.

An adequate characterization of existing impacts for the ponds is necessary to provide a description of the source term for use in constructing a dose assessment relative to planned future conditions. Characterization data currently available is described previously.

Sampling is required to define the horizontal and vertical extent and concentration of impacts for each area to develop a radionuclide-specific source term for any given dose assessment. Assessment of deep soil impacts will not include use of instrumentation for scanning or measurements. Scanning surveys will not be performed for areas of deep impacts.

Samples of soil will be analyzed for the radionuclides of concern as described previously for surface soils. Samples of soil will be collected and prepared as described previously for surface soils with the following exceptions:

- Soil samples will not be collected with respect to 100 m^2 blocks,
- Soil samples will be collected as discreet samples representing a known depth and not as plugs from which to develop composites, and
- Replicate samples will not be collected.

5.5.2.1 Data Assessment

The reference coordinate system will be the same as described previously for sampling surface soils. Background radioactivity will be the same as described previously for sampling surface soils.

Sampling requirements will be calculated statistically using an equation for a given confidence interval of the mean solved for the variable number of data points (*n*) (EPA QA/G-5S). This method of calculating *n* is satisfactory providing *n* is large enough that the distribution of the mean is expected to be approximately normal. As a reasonable element of conservatism, the sample requirements will be chosen from the estimate for the parameter (e.g. thorium-230) that provides the greatest number of required samples. An 80% confidence interval will be considered a reasonable level of certainty for calculation of sampling requirements.

Existing characterization data may be used to develop the sampling requirements for areas of deep soil impacts. The net number of samples needed is the total sampling requirement less the existing number of samples already collected. In cases where no characterization data exists, the sampling requirements may be estimated from data for like areas or selected based on professional judgment. For purposes of the FSS, if no data are available, 30 samples will initially be collected for characterization purposes.

The sample locations may be chosen randomly or placed on a systematic grid with a random starting location. Professional judgment via visual and/or empirical examination of borehole logs will be used to identify the vertical extent of impacts. Subsequently, samples locations will be chosen randomly based on the depth of impacts and the areal boundary.

The adequacy of ARC for closure of the evaporation ponds (and other areas of deep soil impacts) will be demonstrated by comparing results of site specific dose modeling to the benchmark dose.

5.6. QUALITY ASSURANCE AND QUALITY CONTROL

RAM will implement a quality system to ensure that the final status survey decisions are supported by sufficient data of adequate quality and usability for their intended purpose, and further ensure that such data area authentic, appropriately documented, and technically defensible.

A written quality assurance project procedure (QAPP) will be developed for the final status survey effort. The QAPP will be developed using a graded approach. The graded approach will base the levels of controls on the intended use of the results and the degree of confidence needed in their quality. The QAPP will describe the QA/QC requirements regarding survey planning, survey implementation, and results evaluation.

Assessment of the final status survey data will be made to determine if the data meet the objectives of the surveys, and the whether the data are sufficient to determine compliance with the soil concentration limits. The assessment will consist of three phases: data verification, data validation, and data quality assessment.

Data verification efforts will be completed to ensure that requirements stated in planning documents are implemented as prescribed. Identified deficiencies or problems that occur during implementation will be documented and reported. Activities performed during the implementation phase will be assessed regularly with findings documented and reported to management. Corrective actions will be reviewed for adequacy and appropriateness and documented in response to the findings. Data verification activities are expected to include inspections, QC checks, surveillance, and audits.

Data validation activities will be performed to ensure that the results of data collection activities support the objectives of the surveys, or support a determination that these objectives should be modified. The data validation effort will include use of the following data descriptors:

- Reports to Decision Makers of data, changes to the survey plan, and results of verification.
- Three types of documentation that will be assessed include field records, laboratory records, and data handling records.
- Selection and use of appropriate analytical methods and associated detection limits.
- Review of data to assess data quality in terms of completeness with respect to field and laboratory data quality requirements.
- The assessment of data quality indicators to determine data usability. The data quality indicators to be assessed include precision, bias, accuracy, representativeness, comparability, and completeness.

An assessment of data quality will be performed to determine if the data are of the right type, quality, and quantity to support their intended use. The assessment will include review of relation between survey objectives and design; an evaluation of the data using basic statistical and graphical representations, and quality assurance reports; selection of statistical tests; verifying assumptions of statistical tests; and performing the statistical tests and drawing conclusions with respect to the survey plan objective.

5.7. NON-RADIOLOGICAL HAZARDOUS CONSTITUENTS

Based on historical site operations and the available data, significant concentrations of non-radiological hazardous constituents are not expected to exist at the site as the pond area did not contain any processing buildings. The facilities were limited to the lined ponds and the transfer pipeline.

In the event that an area indicates evidence of possible non-radiological impacts attributable to pond activities in an area that is removed from the affected area, Rio Algom will perform sampling to determine the extent of the impacted area. If the impacted area is due to activities associated with the pond operations, appropriate reclamation actions will be undertaken.

6.0 HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION

6.1. 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.

6.2. 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 BHPBilliton 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.

6.2.1. 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.

6.2.2. 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.

6.2.3. 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 3 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.

6.2.4. 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.

6.2.5. 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.

6.2.3.1. 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.

6.2.5.2 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.

6.2.5.3 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.)

6.2.6. 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.

7.0 RECLAMATION COSTS

7.1. 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.

7.2. SCOPE OF WORK

The Scope of Work for the decommissioning of the lined ponds 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 6-inch lift to be compacted to 90% standard proctor density. Estimated volume: 1,966,000 cy.

- Contaminated Soils Cleanup - this work area includes the delineation of potentially contaminated soils near and under the former lined ponds. The work area also includes the physical cleanup of contaminated soils, haulage and placement of these soils on Pond 2. Estimated volume: 150,000 cy.

- 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 decommissioning activities. Additionally, the material handled during the decommissioning effort will possess some low-level radioactivity, and the work will be performed under the sites health physics program. The costs associated with this portion of this work area include personnel monitoring, survey for release, and HP staff.

7.3. COST ESTIMATE

The cost estimate found in Table 7-1 follows the Scope of Work provided above. The basis for the cost estimate results from third party contractor bids and estimates based on site experience provided by 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 7-1
Cost Estimate for the Decommissioning of the Lined Evaporation Ponds

Work Area	Estimated Cost	Basis
1. Mobilization	$993,000	3rd Party Contractor Bid
2. Road Crossing Construction	$420,000	3rd Party Contractor Bid
3. Sediment/Berm Removal (Section 4)	$8,784,000	3rd Party Contractor Bid
4. Contaminated Soils Cleanup (Pond 9)	$312,000	3rd Party Contractor Bid
5. Contaminated Soils Cleanup (Section 4)	$902,000	Rio Algom Estimates (site experience)
6. Re-contouring and Revegetation (Section 4)	$236,000	3rd Party Contractor Bid
7. Site Management and HP Support	$650,000	Rio Algom Estimates (site experience)
Total Costs:	**$12,297,000**	

8.0 REFERENCES

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Bostick, K. 1985. Ground-water discharge plan analysis for Kerr-McGee Nuclear Corporation, Ambrosia Lake Uranium Mill, Quivira Mining Company, New Mexico. Environmental Improvement Division Unpublished Report. 86p.

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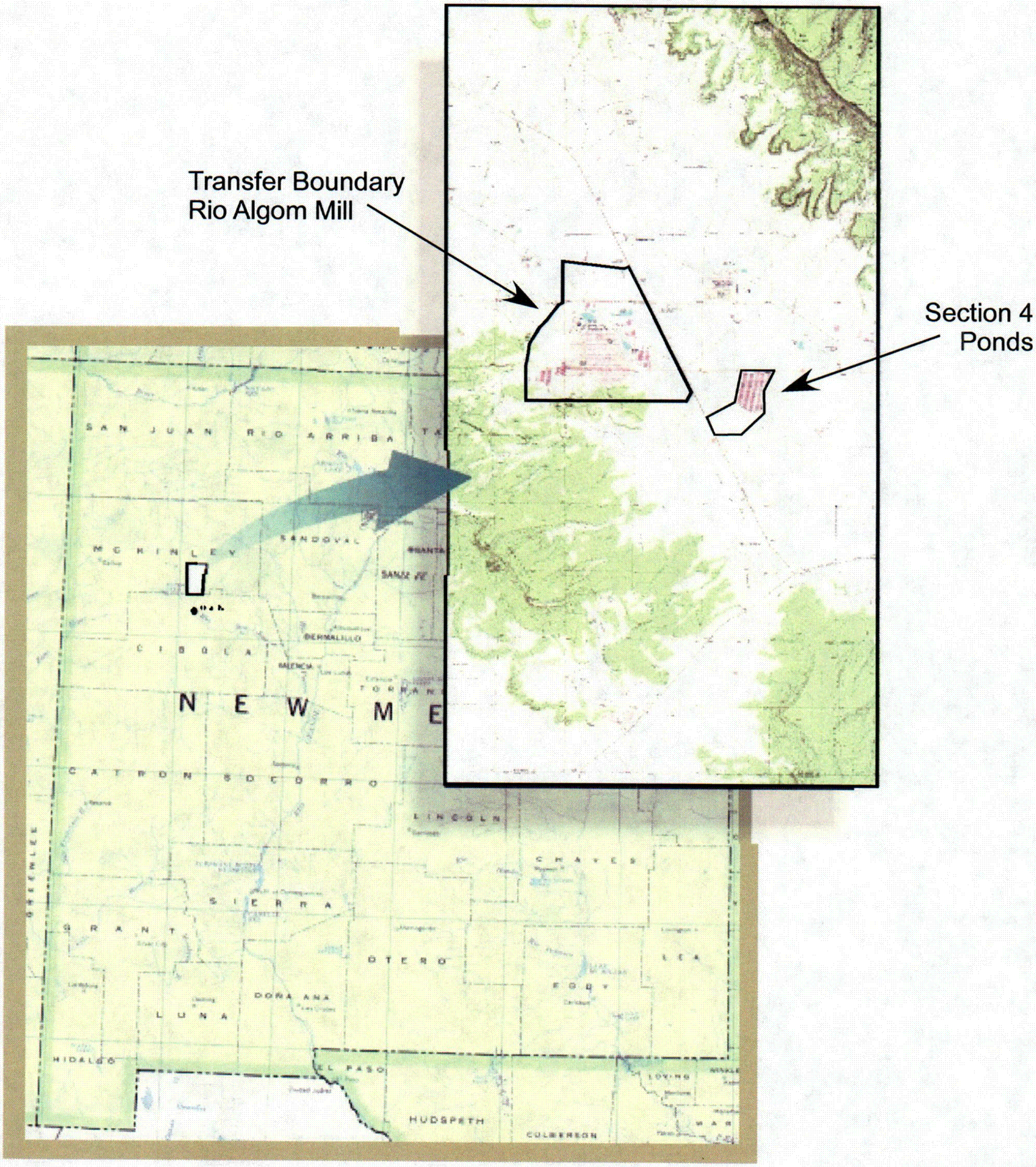


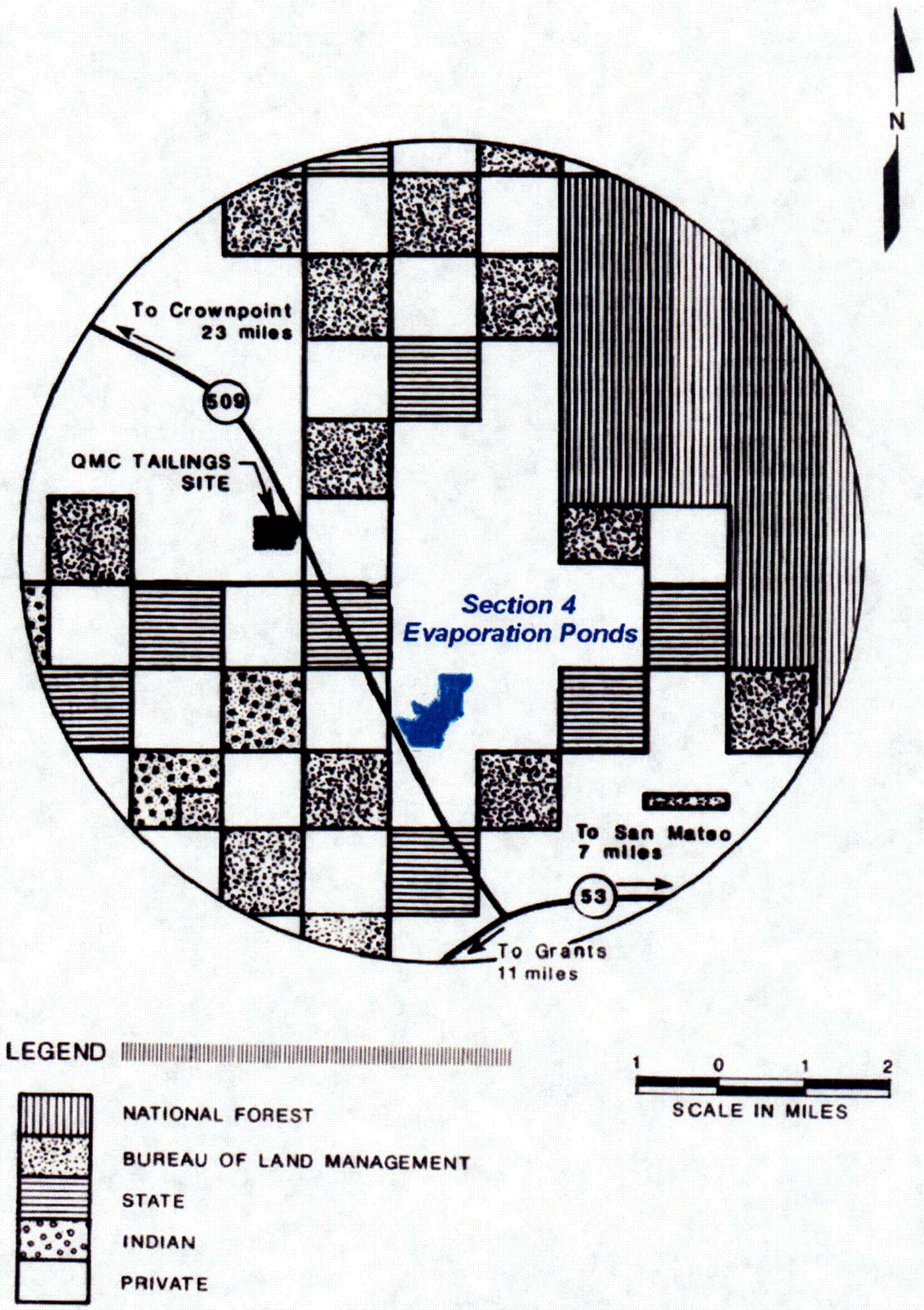
Location Map

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

MAXIM
TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 1-1

C01



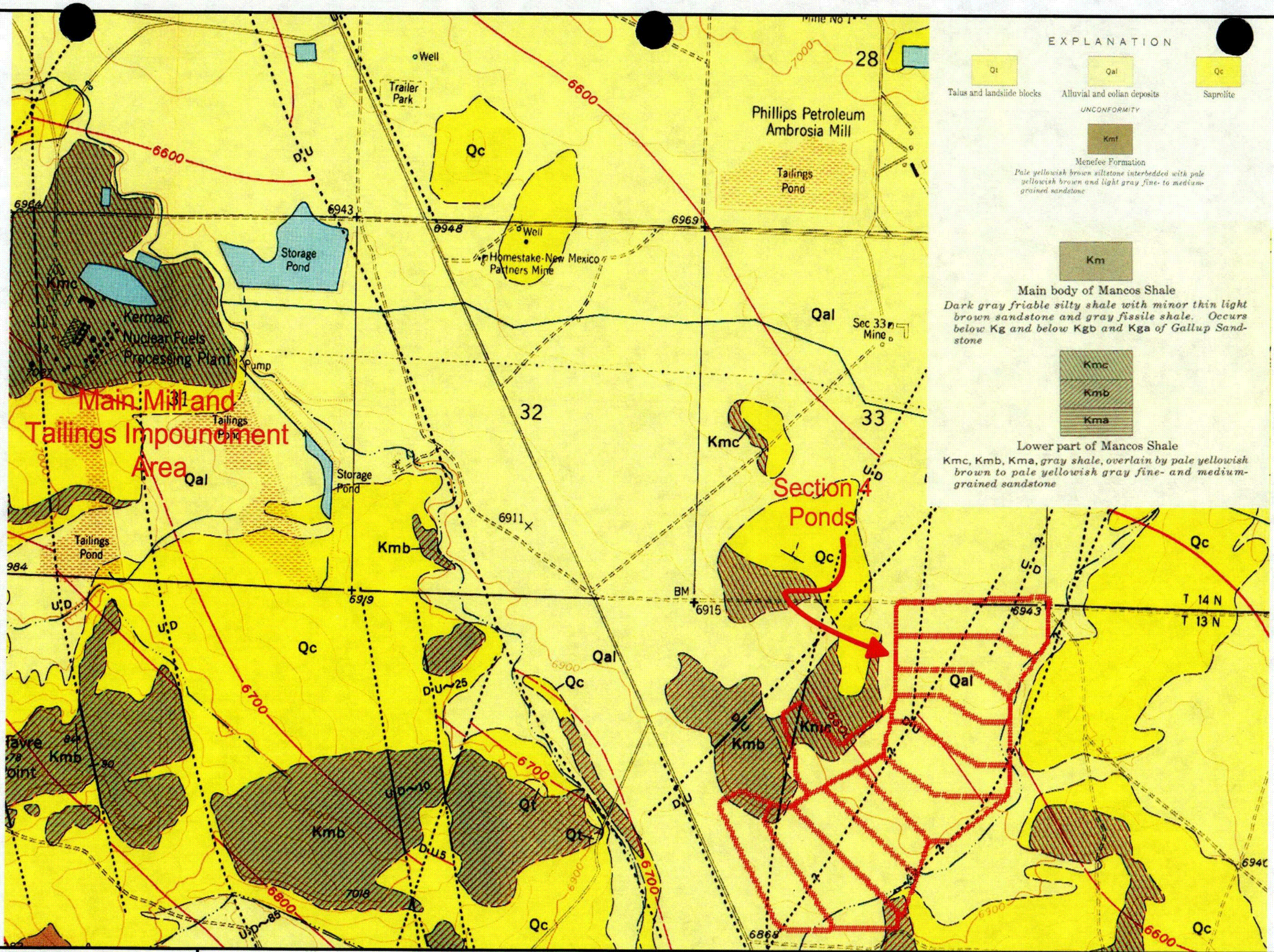
Vicinity Land Use

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-1

C02



Drawing By: DWE Date: 05/08/04 Checked By: DWE Date: 05/08/04	Figure 2-2. Geologic Map of Lined Section 4 Ponds .Area from Santos (1966)
Project No. 1690030 File Name:Figure 2-10	Rio Algom Mining Company Ambrosia Lake Facility, Grants New Mexico

MAXIM TECHNOLOGIES INC

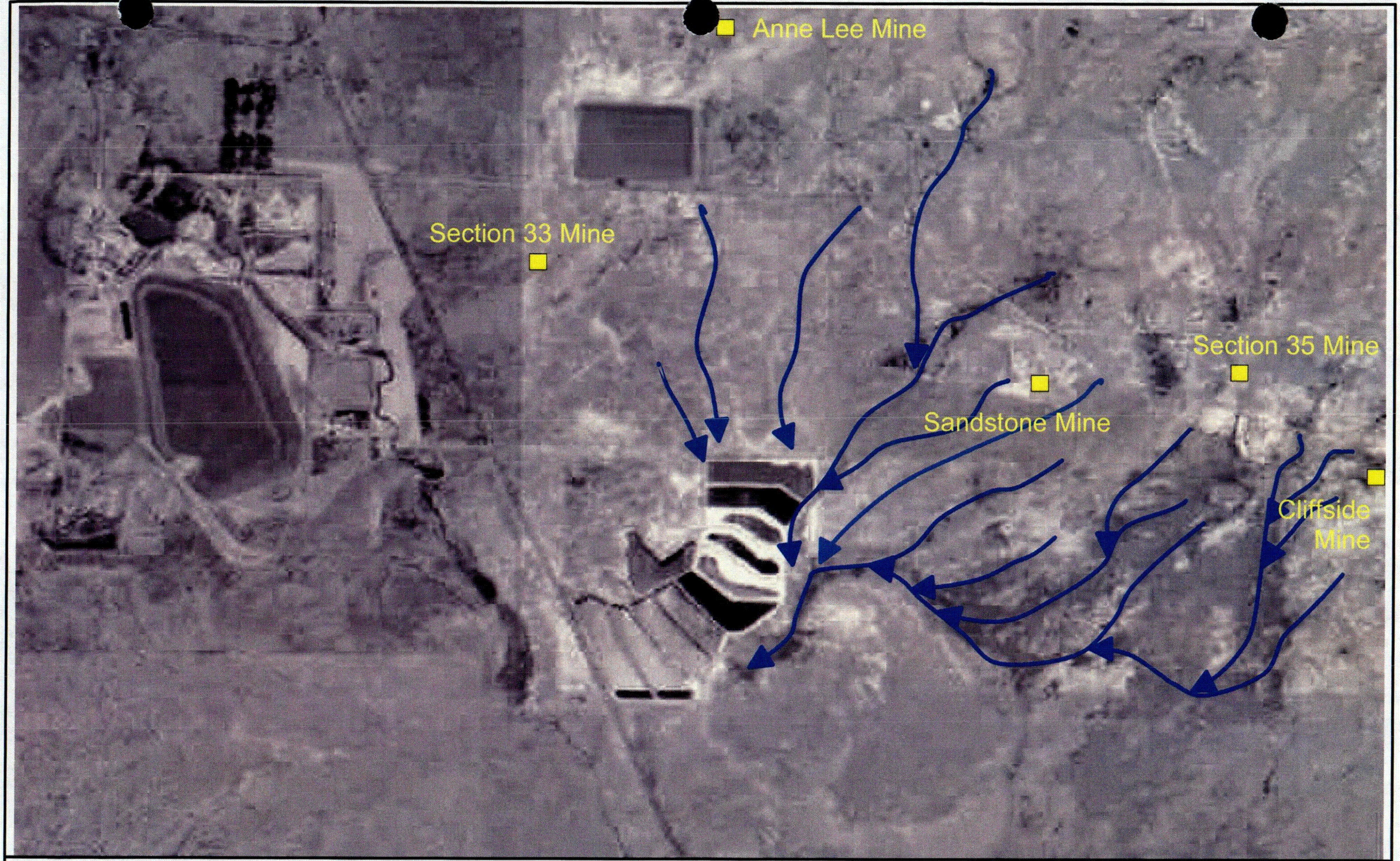
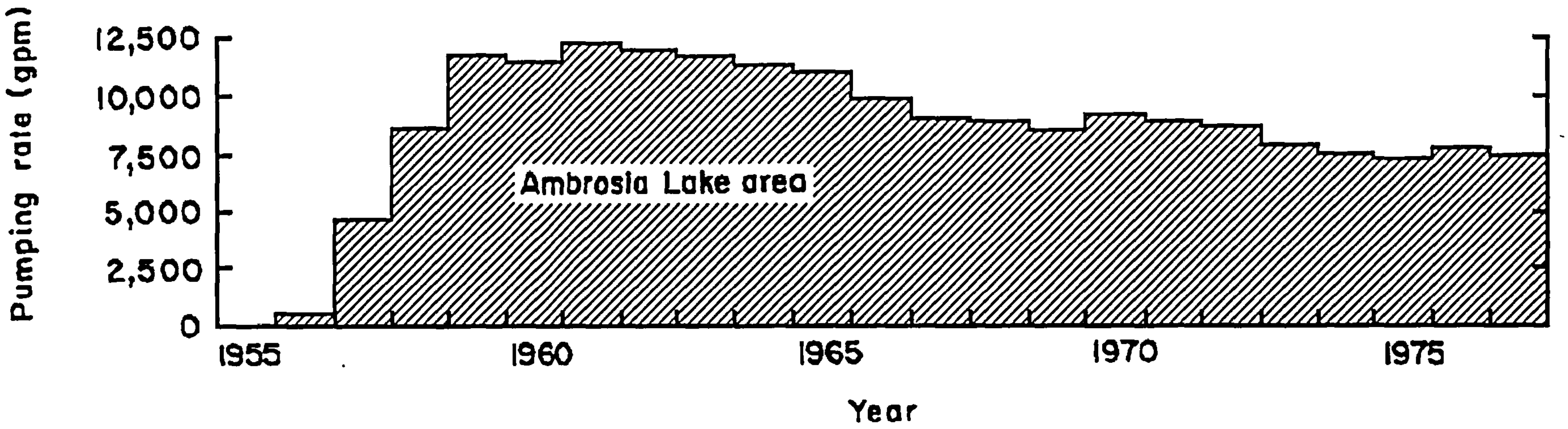


Figure 2-3. Mine Discharge Channels (Blue Arrows)

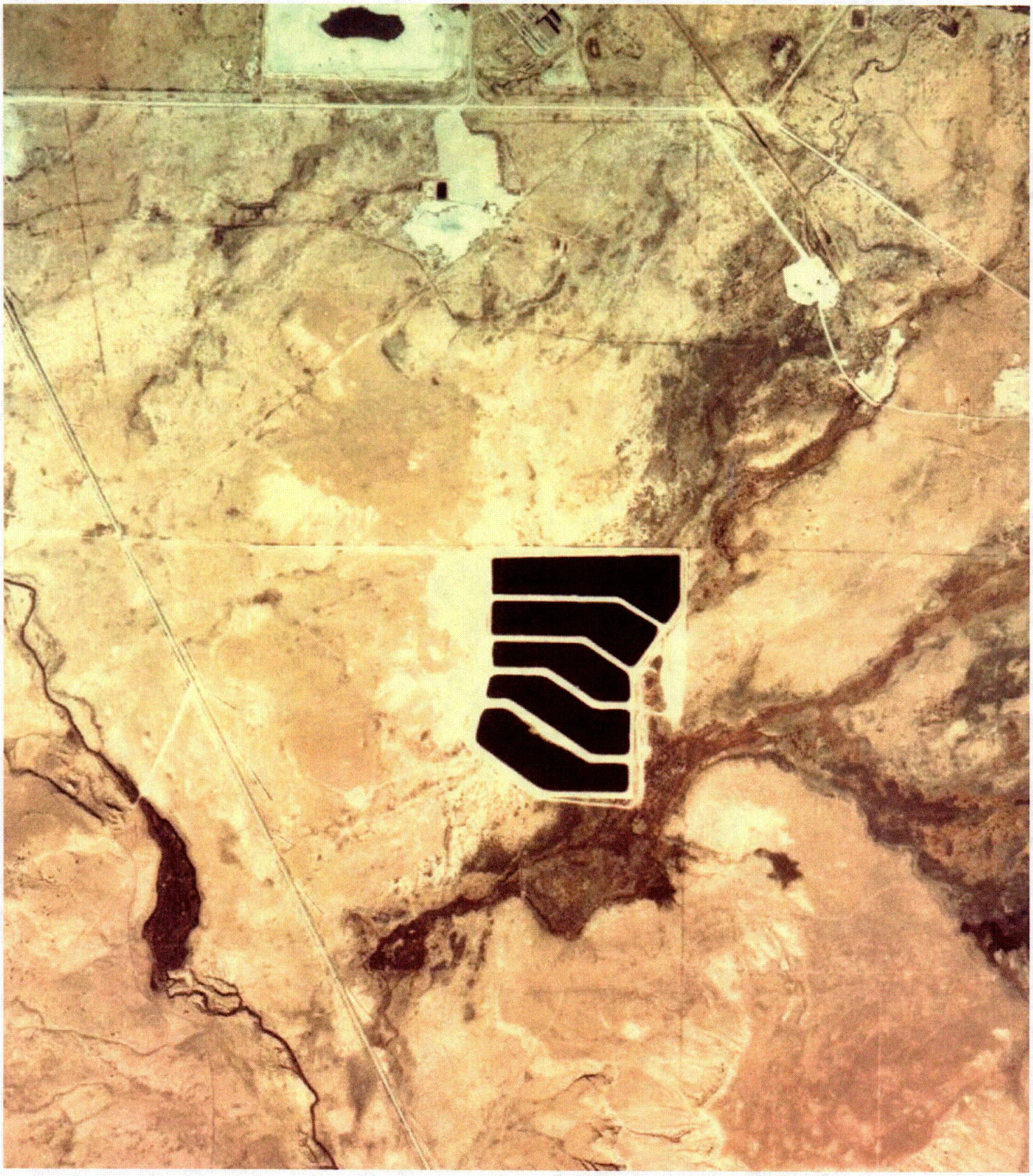
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC®

C04



Water Production by Uranium Mines, 1955 - 1977			MAXIM TECHNOLOGIES INC®
AMBROSIA LAKE MILL RIO ALGOM MINING COMPANY GRANTS, NEW MEXICO			
Project No. 4690029	Drawing By: AEA	Date: 09/07/04	Figure 2-4
File Name: Water Production.dsf	Checked By: DWE	Date: 10/28/04	



1977 Aerial Photo of Section 4 Pond Area

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

MAXIM
TECHNOLOGIES INC®

Project No. 4690029

Drawing By: AEA

Date: 09/07/04

Checked By: DWE

Figure 2-5

C05

2004 Aerial Photo of Section 4 Pond Area

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

MAXIM TECHNOLOGIES INC®

Project No. 4690029

Drawing By: AEA

Date: 09/07/04

Checked By: DWE

Figure 2-6

C06

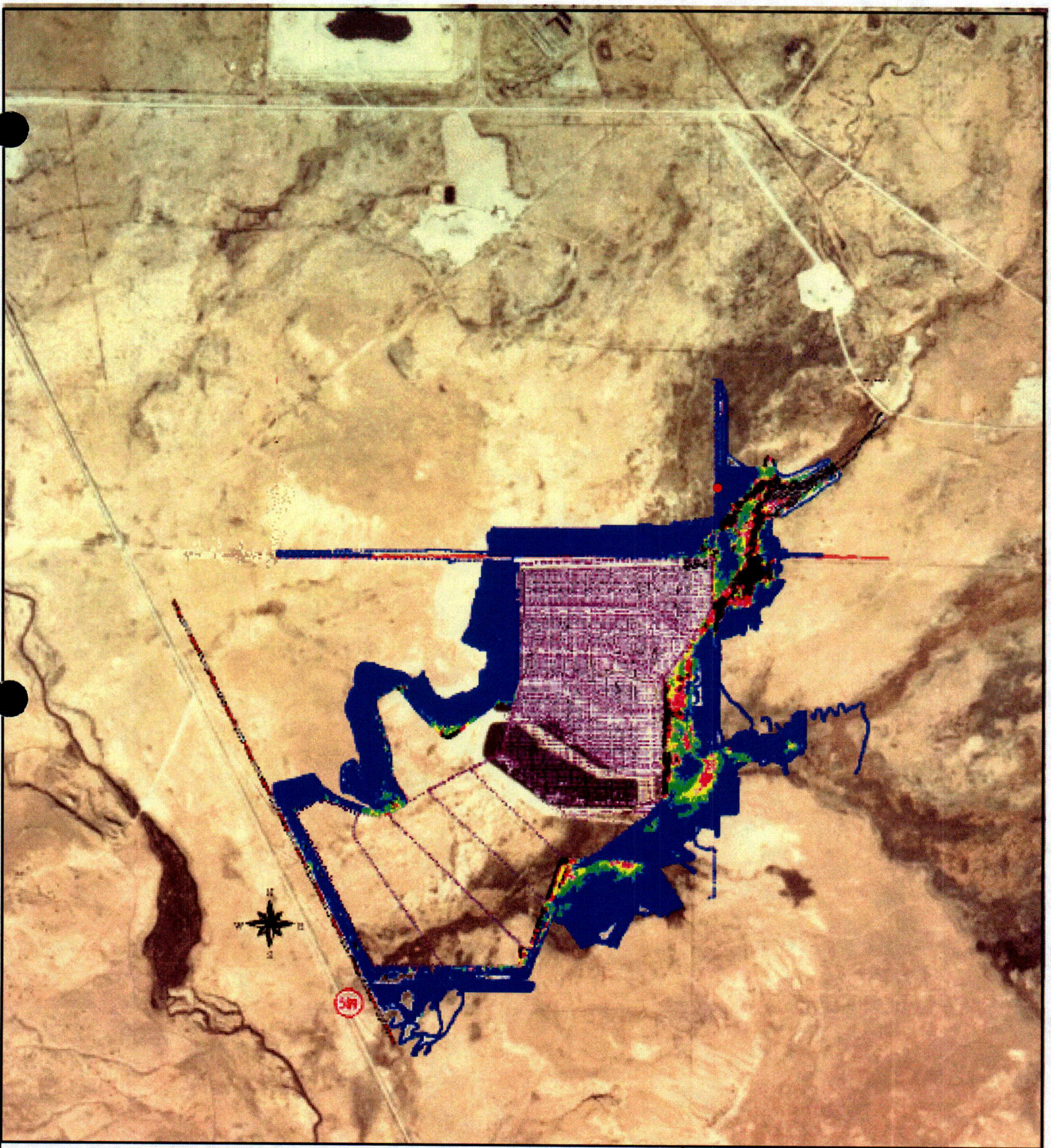


Figure 2-7. Gamma Radiation Survey Results

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

MAXIM TECHNOLOGIES INC®

C07

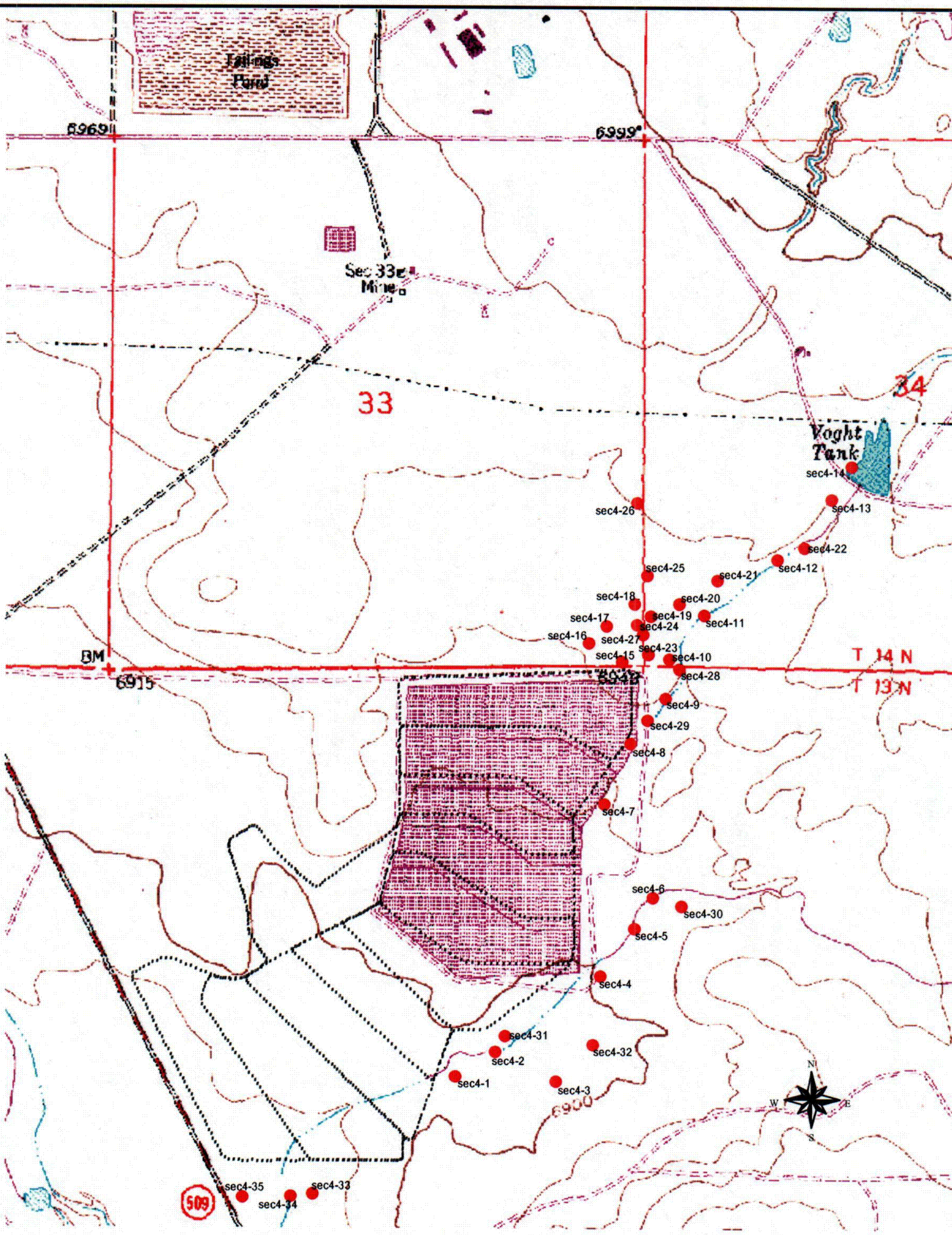


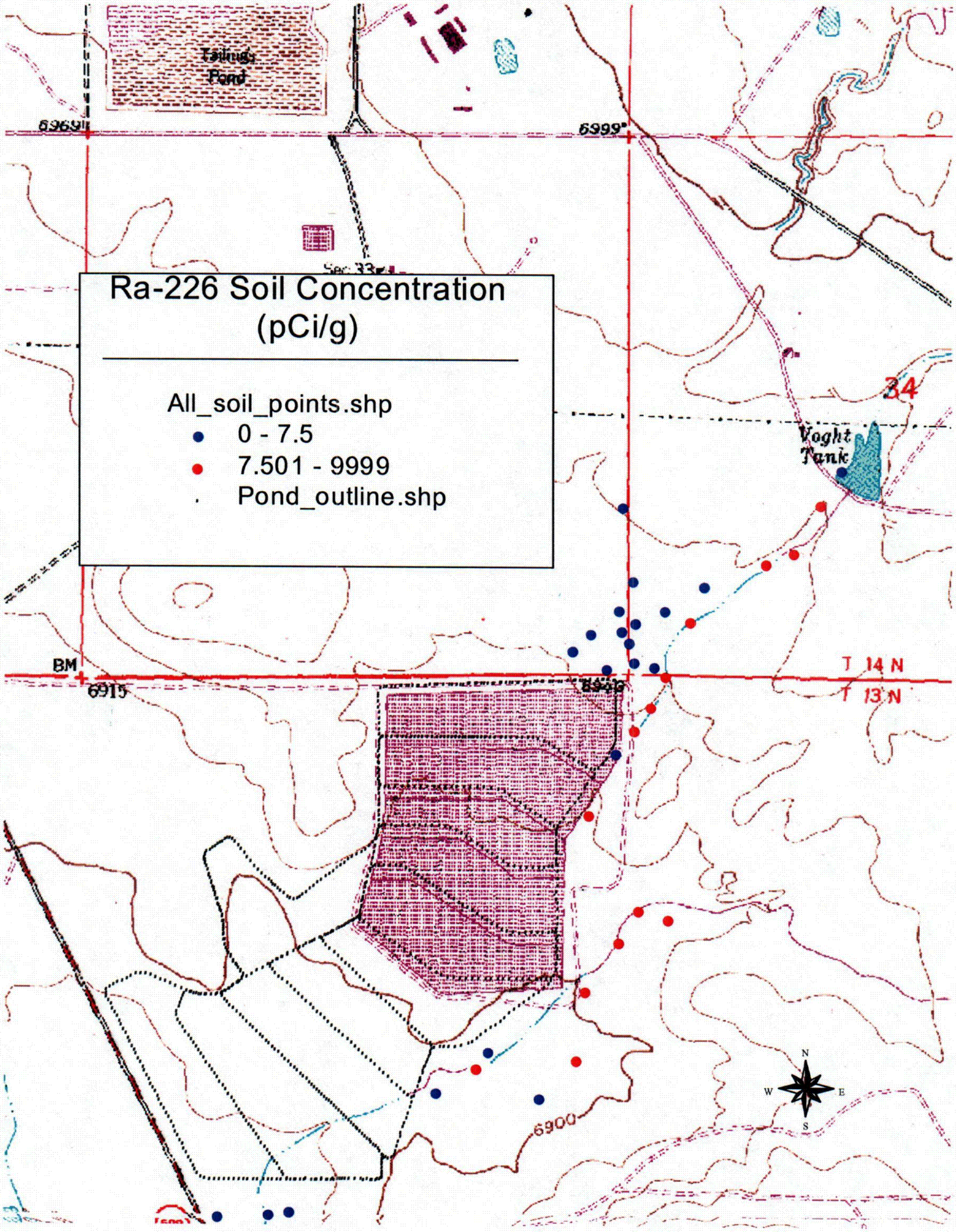
Figure 2-8. Sample Location Map

Rio Algom
Ambrosia Lake, New Mexico.

MAXIM TECHNOLOGIES INC®

Project No. 4690029	Drawing By: AEA	Date: 07/08/04
File Name: sec4_soil_sample_map.dsf	Checked By: DWE	Date: 00/00/00

C08



Ra-226 Soil Concentration

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

MAXIM TECHNOLOGIES INC®

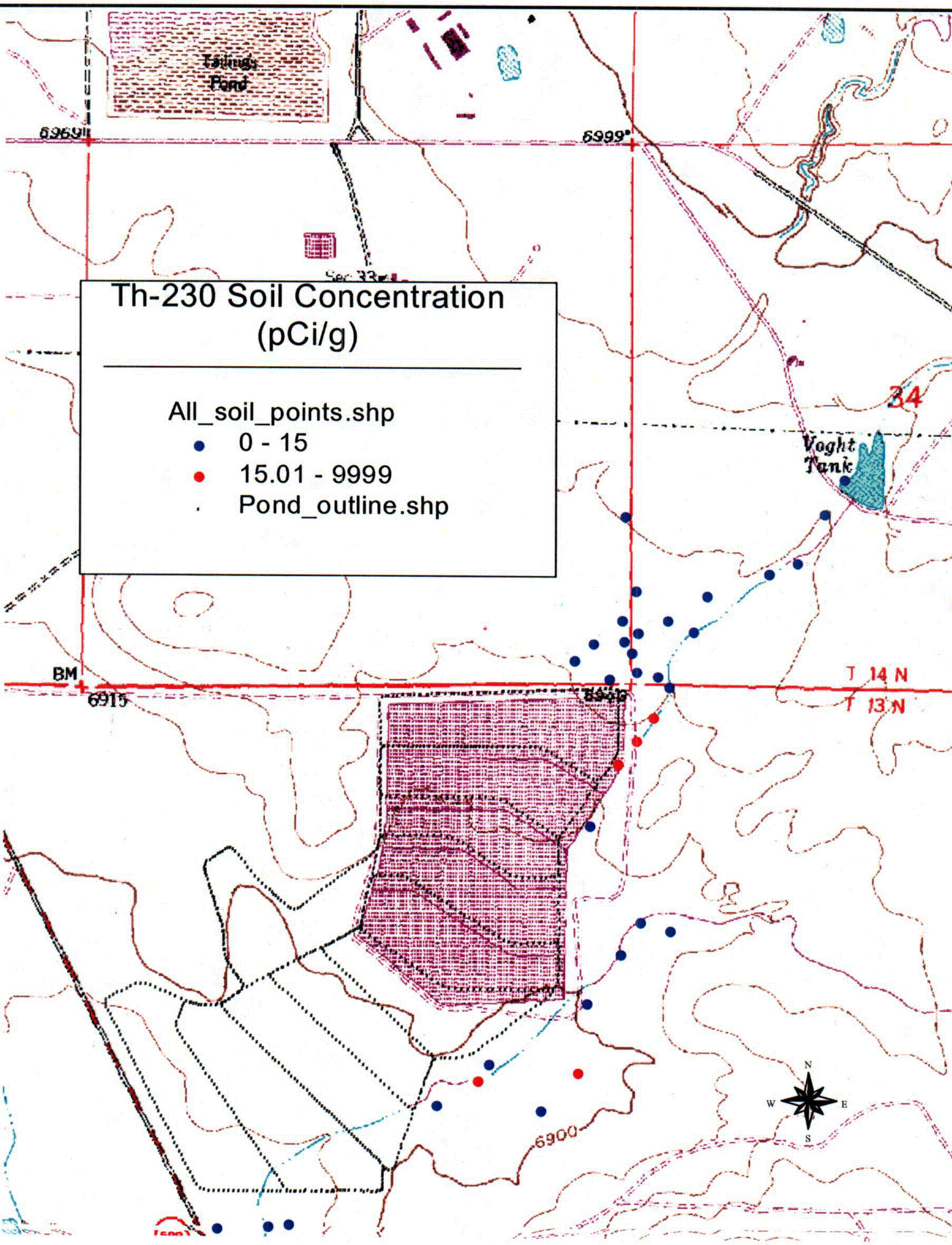
Project No. 4690029

Drawing By: AEA Date: 07/08/04

Checked By: DWE

Figure 2-9

C09



Th-230 Soil Concentration

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

MAXIM TECHNOLOGIES INC®

Project No. 4690029

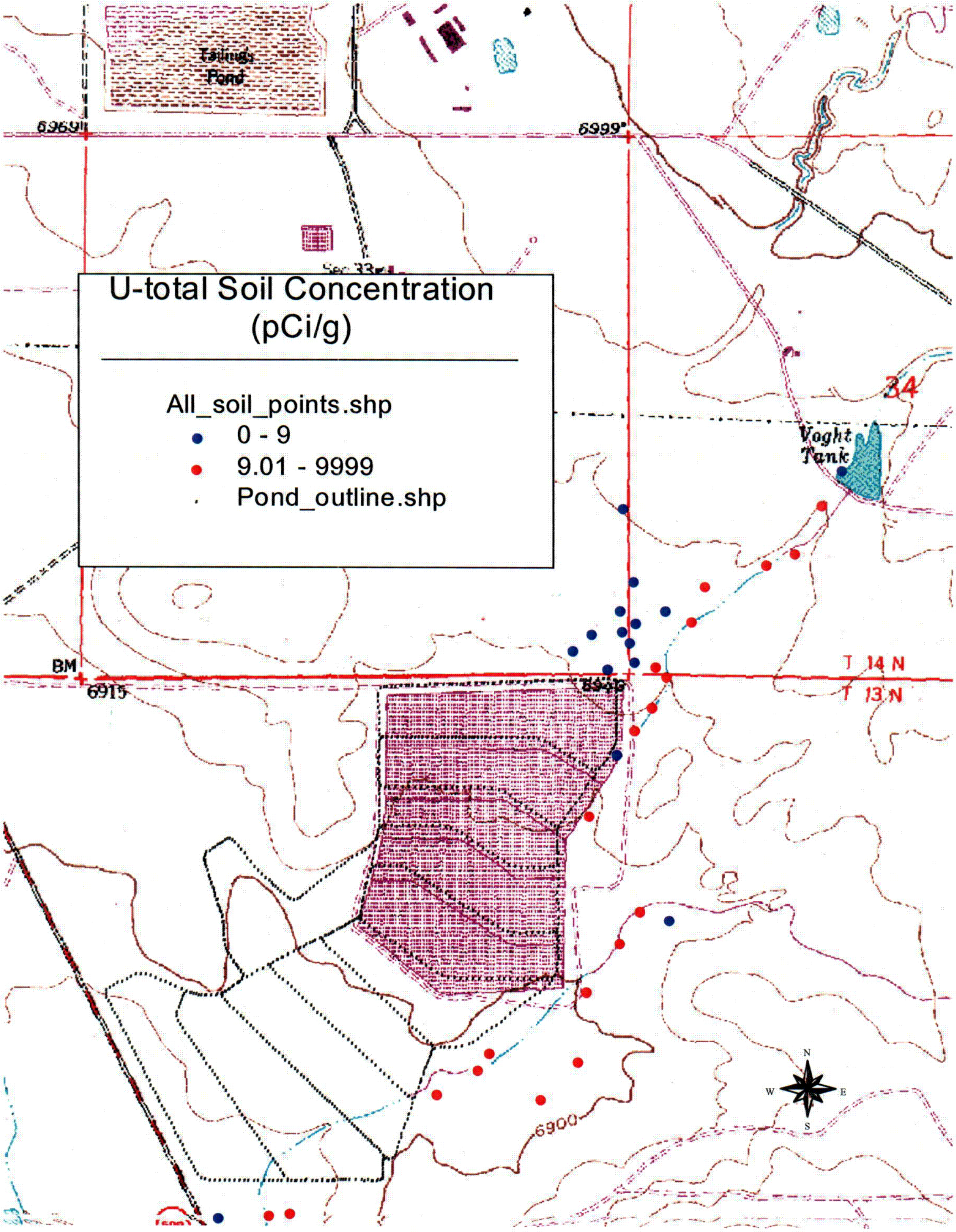
Drawing By: AEA

Date: 07/08/04

Checked By: DWE

Figure 2-10

C10



U-total Soil Concentration

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

MAXIM TECHNOLOGIES INC®

Project No. 4690029

Drawing By: AEA

Date: 07/08/04

Checked By: DWE

Figure 2-11

C11

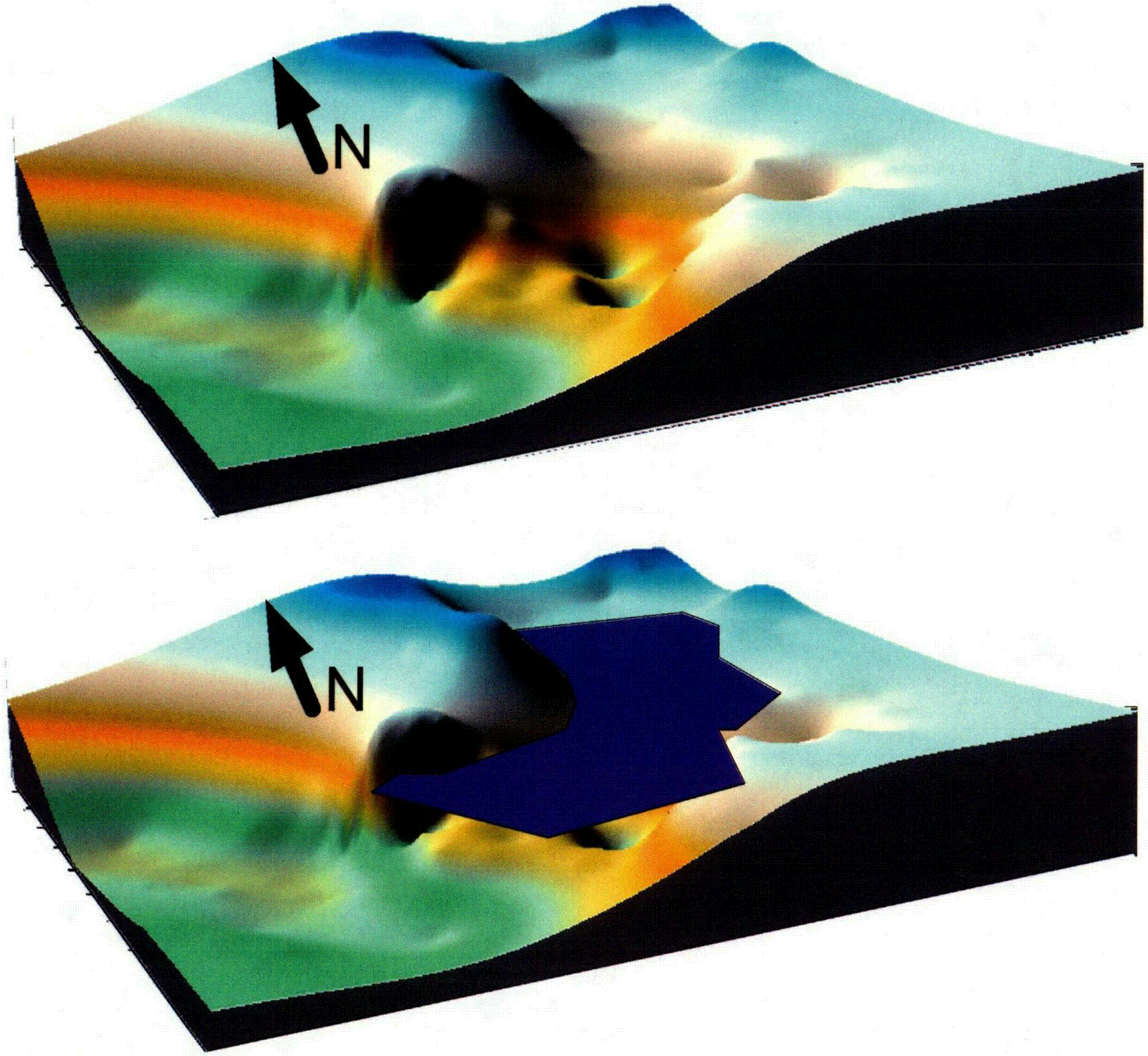


Diagram is infered from 53 soil boring logs. The location of lined ponds is depicted in blue on lower diagram.

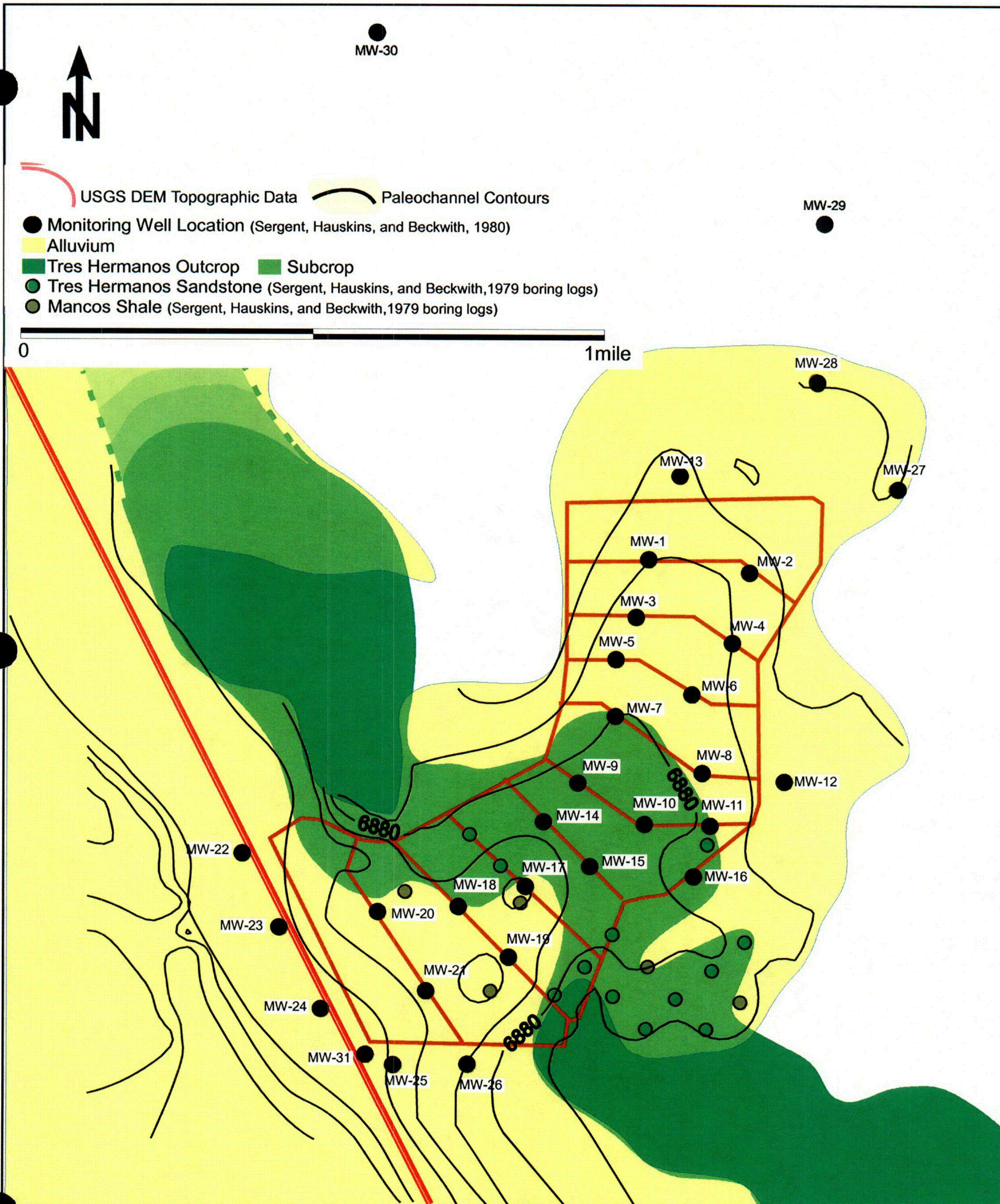
Block Diagram of Paleochannel

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

MAXIM TECHNOLOGIES INC

Figure 2-12

C12



Ponds with monitoring well locations, surface, and bedrock contours showing outcrop and subcrop of the Tres Hermanos Sandstone.

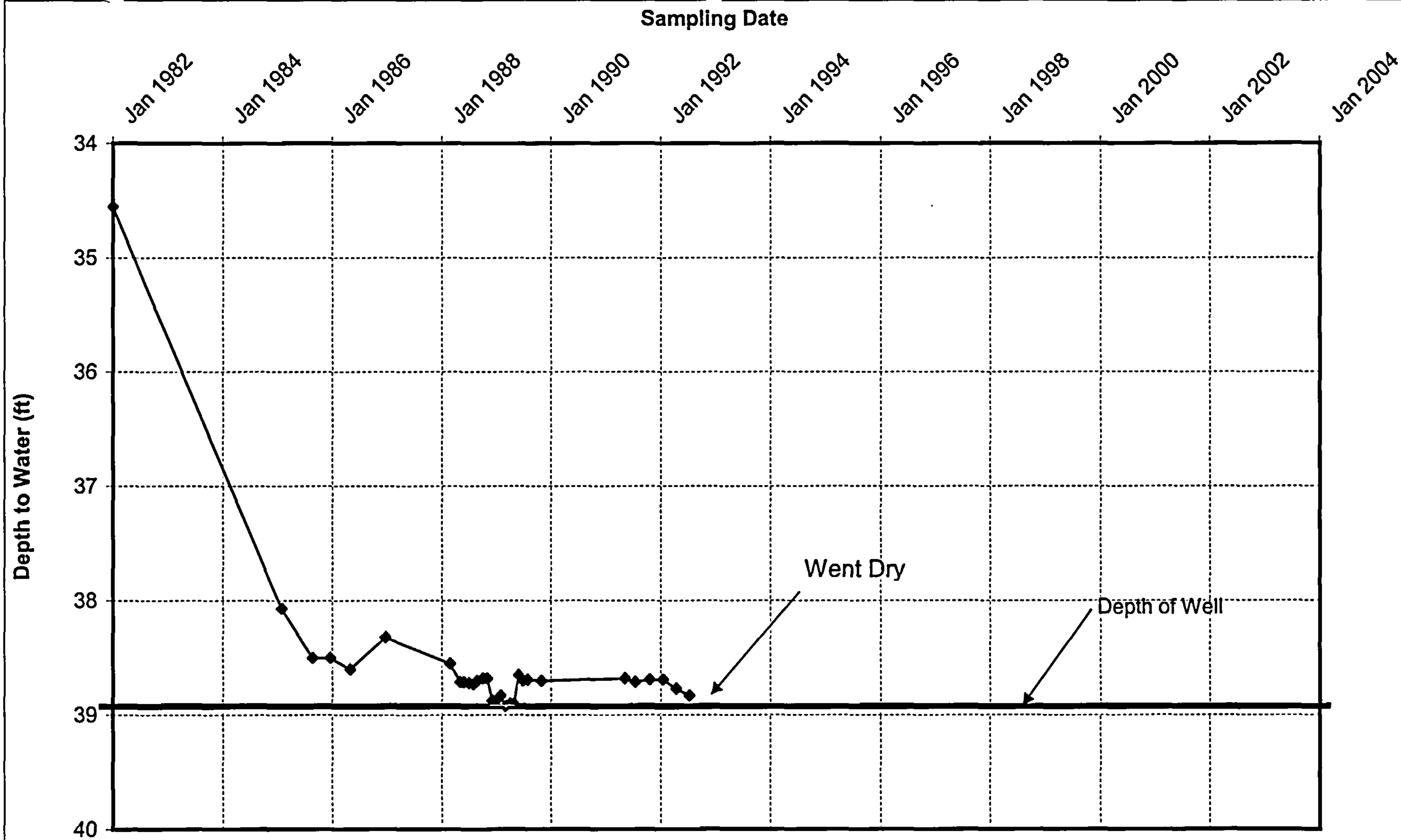
Monitor Well Locations

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

MAXIM TECHNOLOGIES INC®

FIGURE 2-13

C13



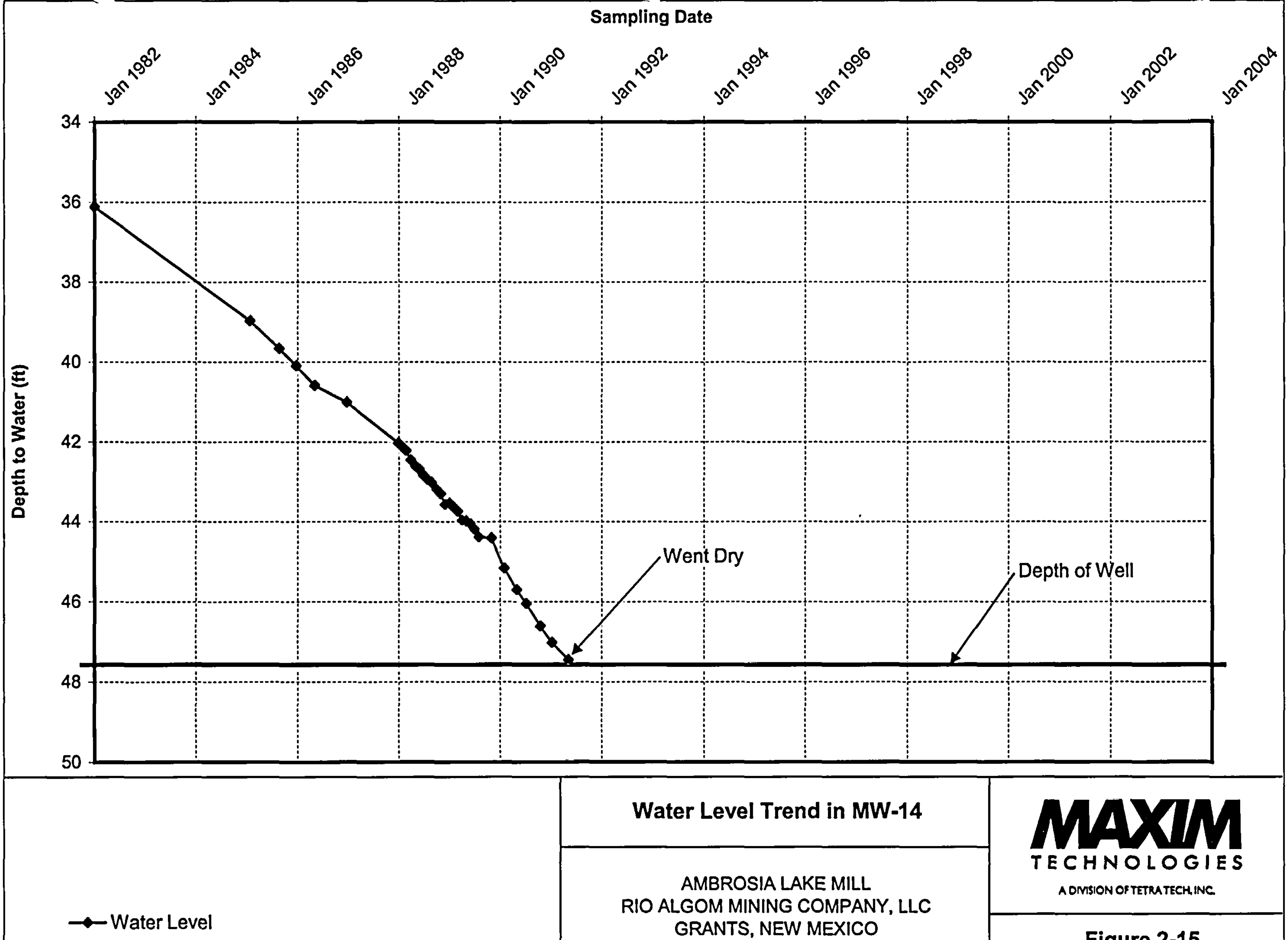
Water Level

Water Level Trend in MW-7

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-14

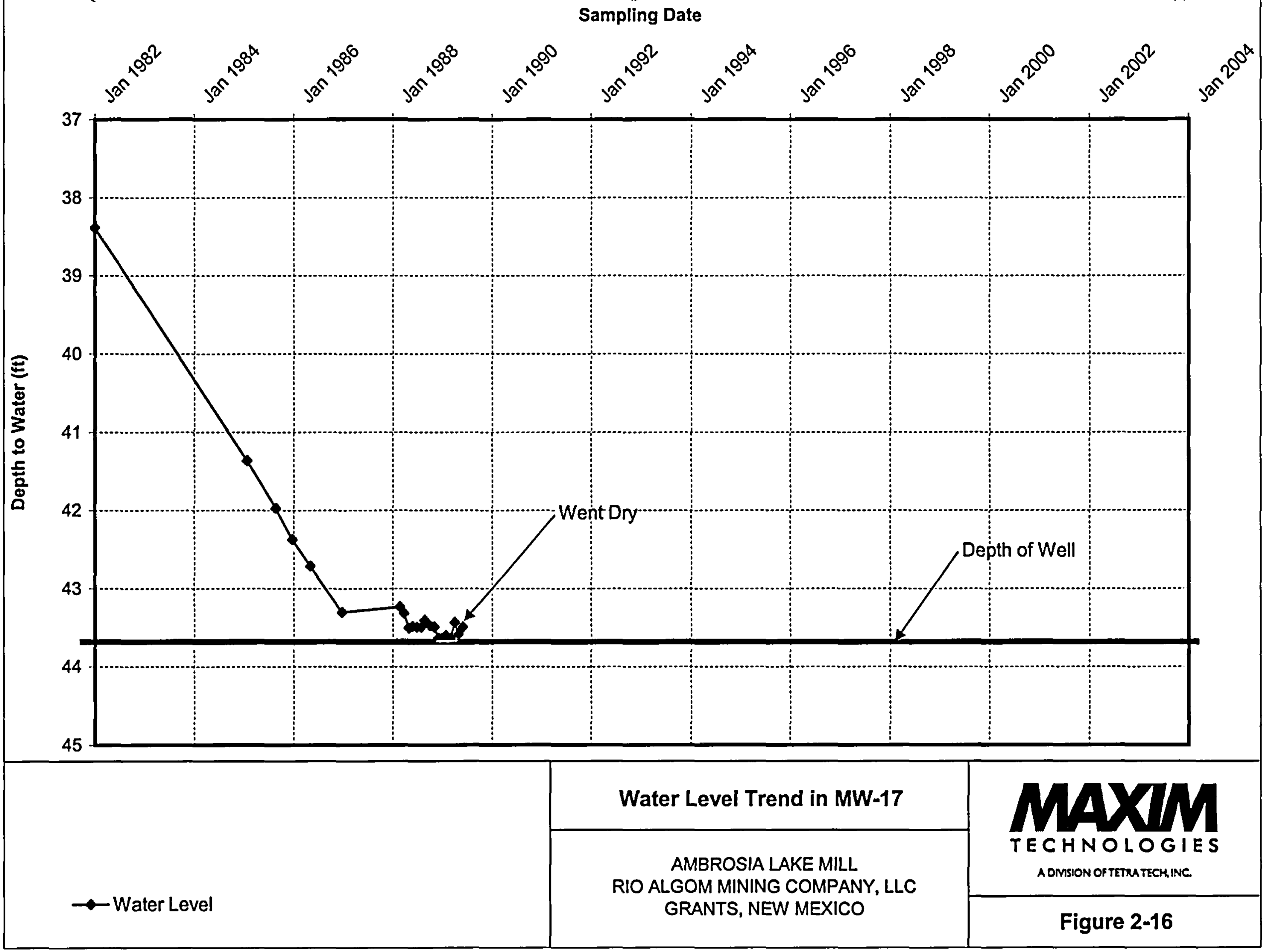


Water Level Trend in MW-14

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-15

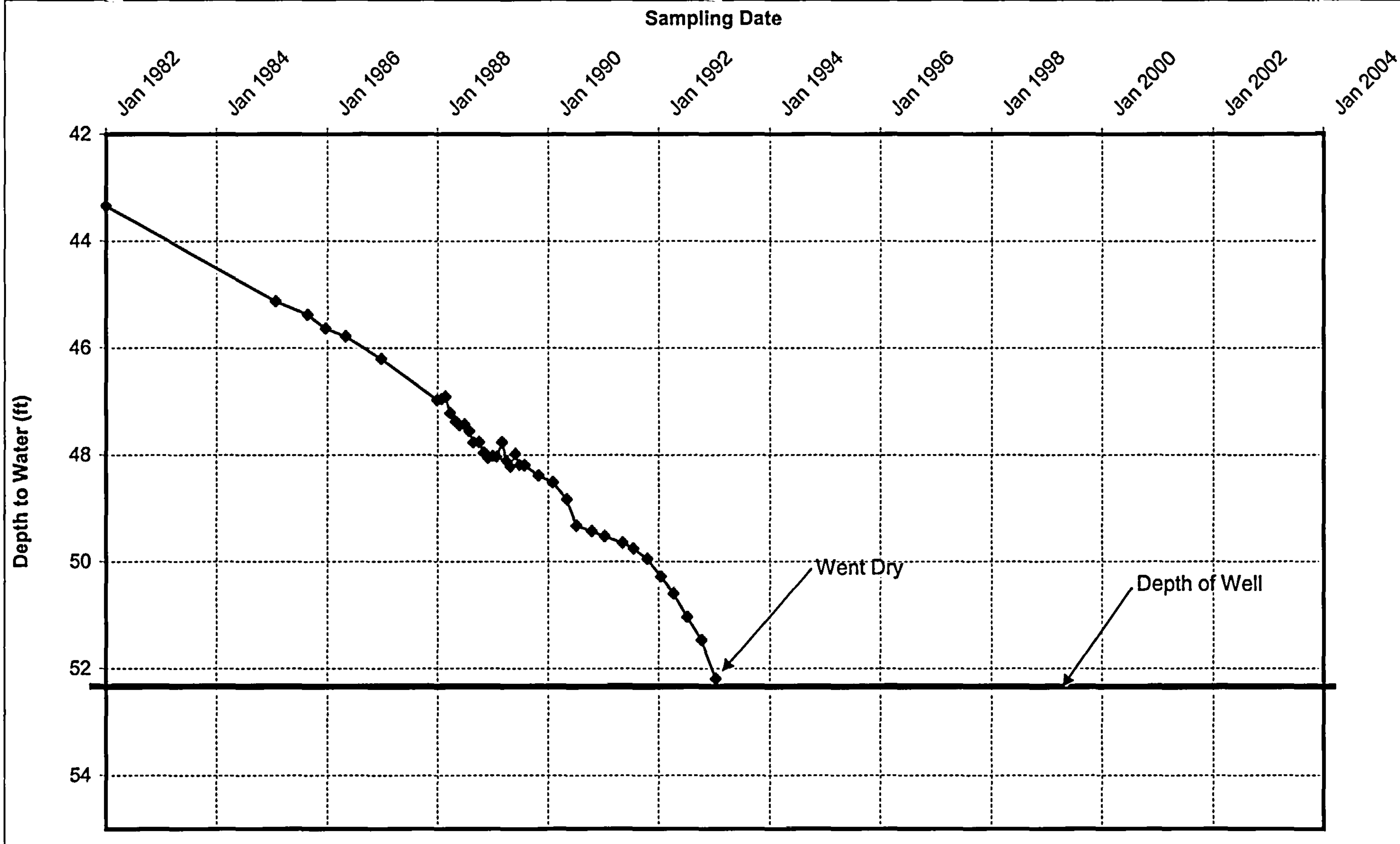


Water Level Trend in MW-17

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-16

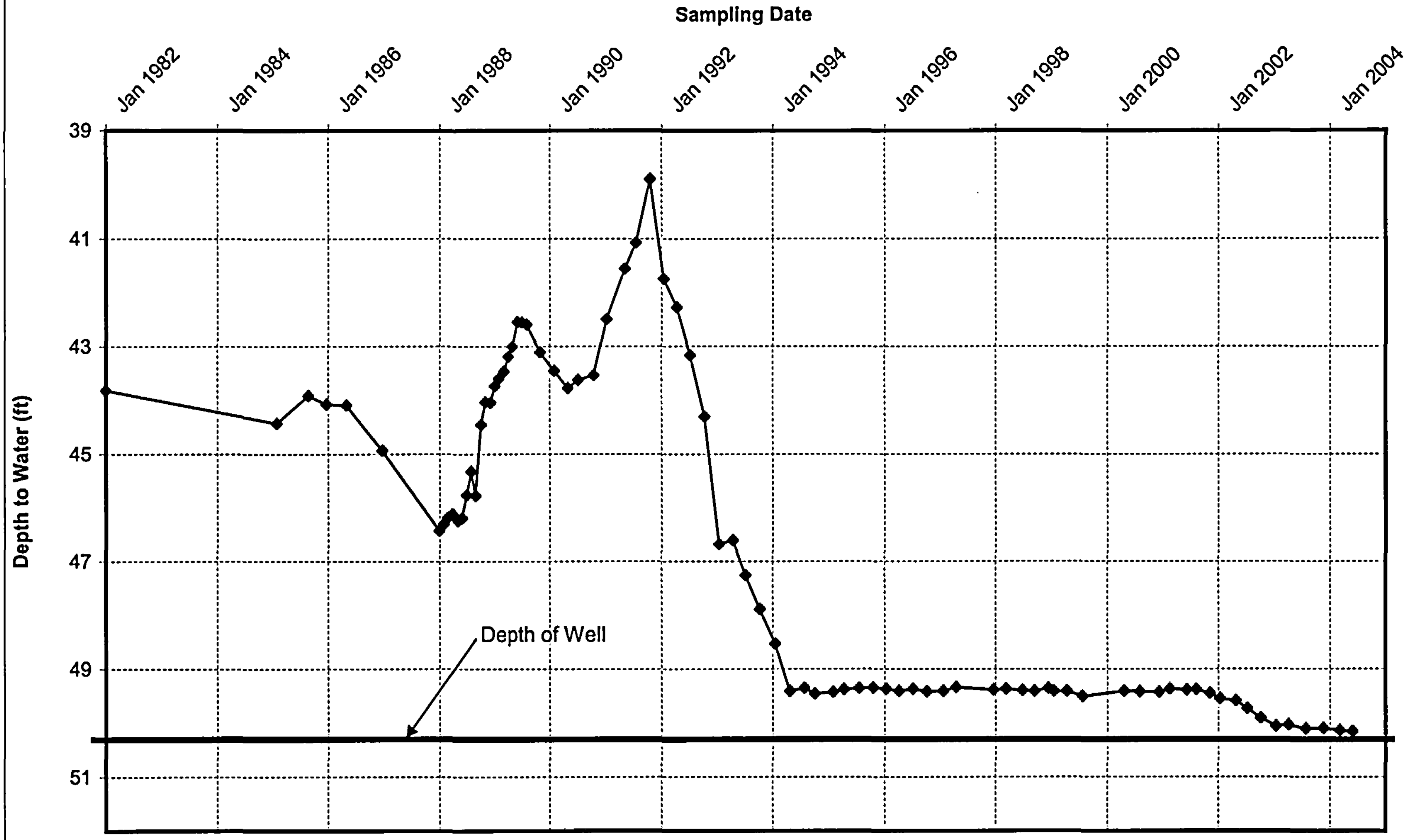


Water Level Trend in MW-21

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-17

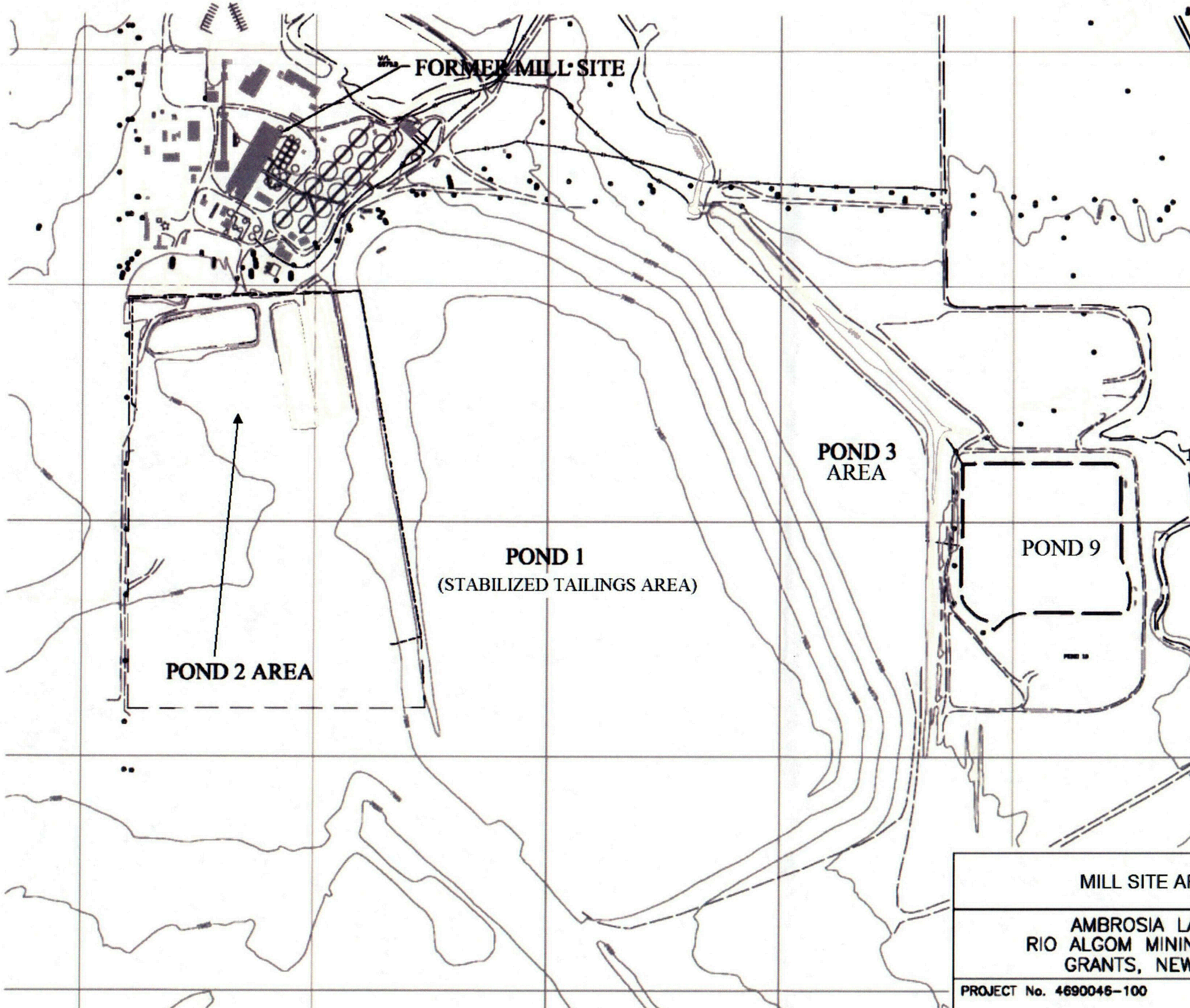


Water Level Trend in MW-24

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

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Figure 2-18



MILL SITE AREA MAP

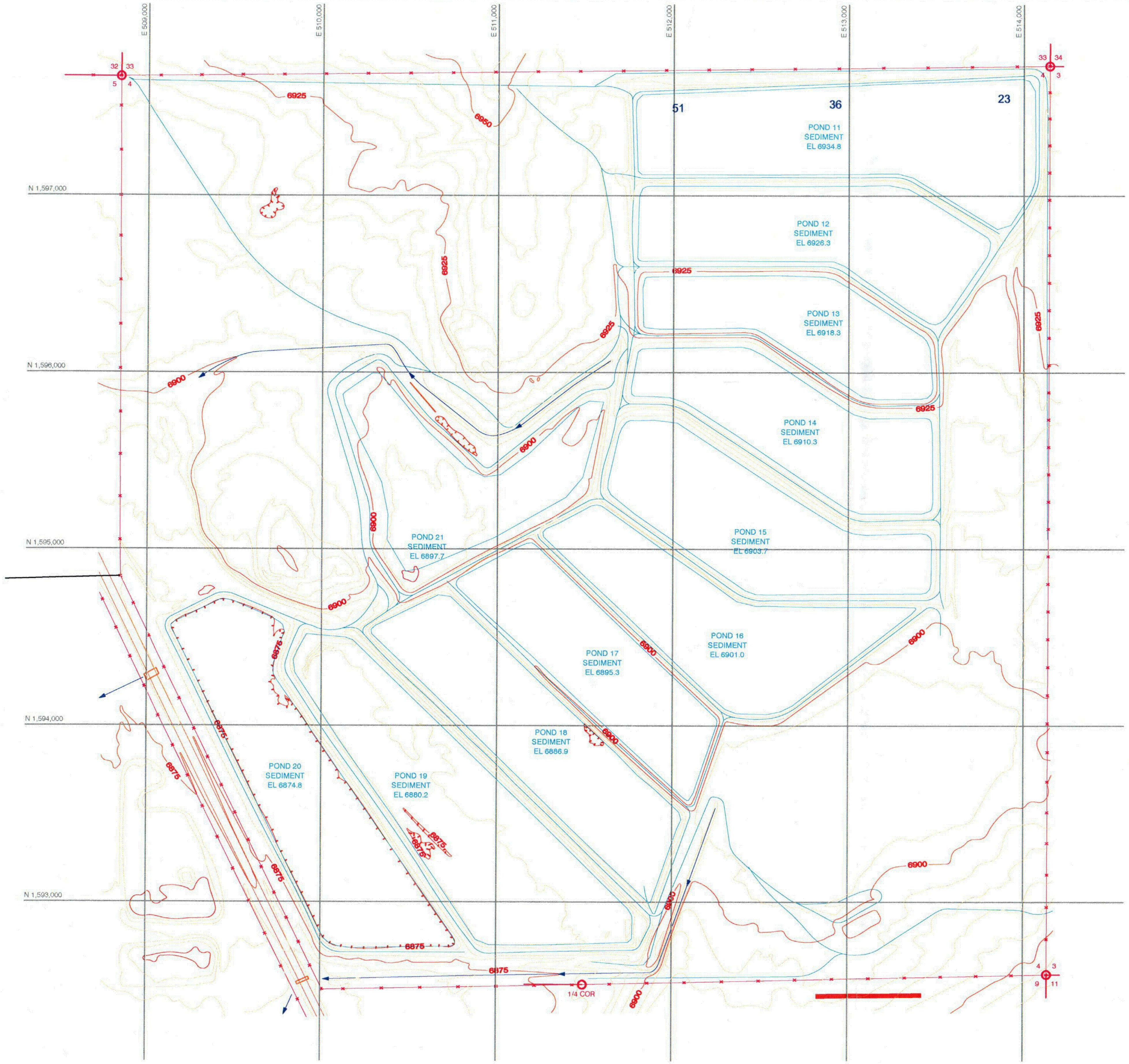
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

PROJECT No. 4690046-100 | DRAWING BY: RLH 5/13/04
FILE NAME: 4690046 FIG 1.DWG | REVIEWED BY: JMM

FIGURE 3-1

C14



NOTES:

1. CREST ELEVATIONS

POND 11: 6942.0 FT	POND 16: 6906.5 FT
POND 12: 6932.5 FT	POND 17: 6900.0 FT
POND 13: 6927.5 FT	POND 18: 6896.3 FT
POND 14: 6920.5 FT	POND 19: 6890.3 FT
POND 15: 6912.5 FT	POND 20: 6883.3 FT
	POND 21: VARIABLE

2. AVERAGE SEDIMENT ELEVATION PROVIDED. ACTUAL SEDIMENT ELEVATIONS VARIABLE WITHIN EACH POND. SEDIMENT THICKNESS SHOWN IN INCHES AT SPOT LOCATIONS.

3. TOPOGRAPHY ADAPTED FROM UNDATED KOOGLE & POURS ENGINEERING DRAWING.

0 20 40
SCALE IN FEET
(APPROXIMATE)

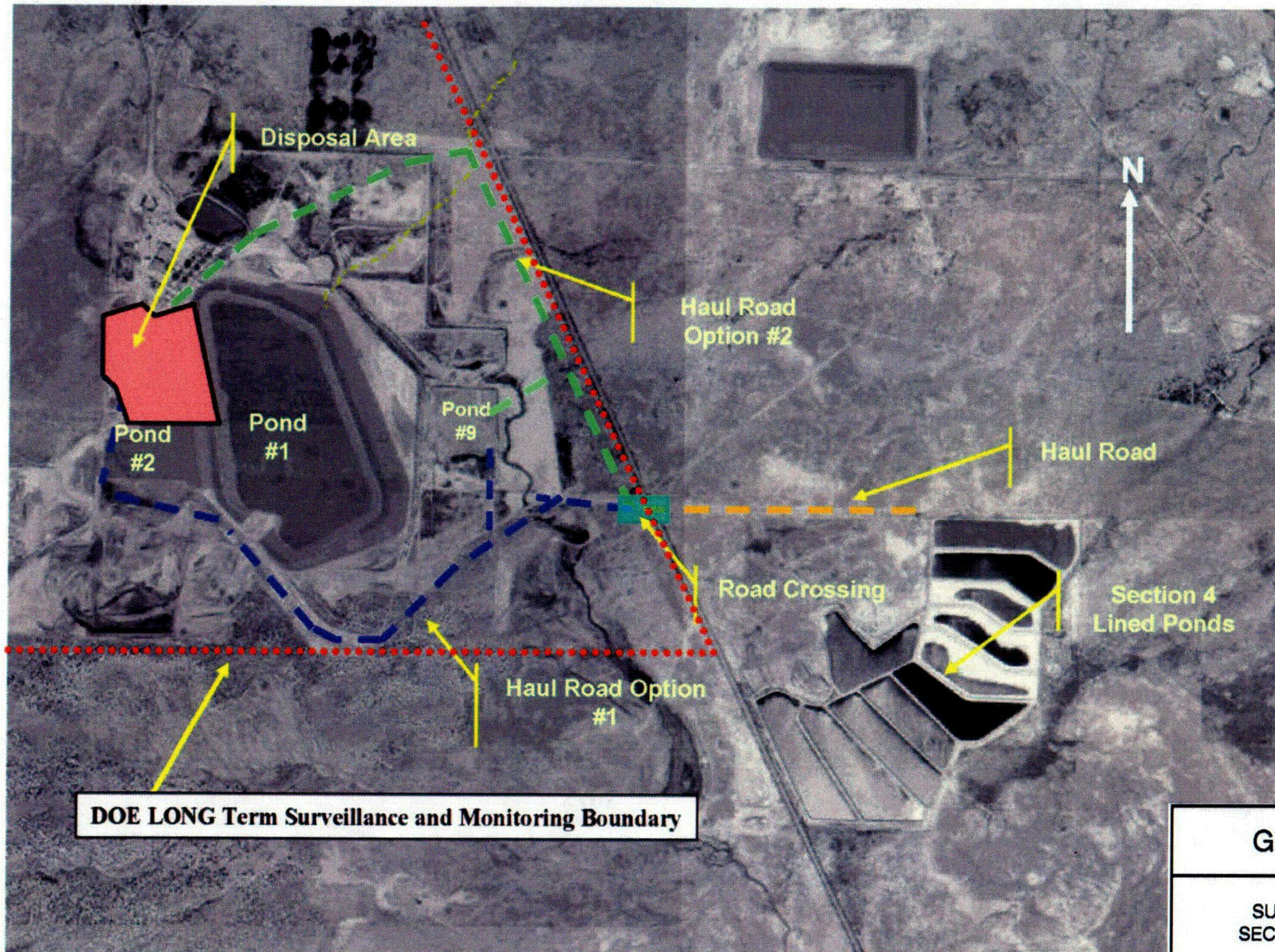
SECTION 4 PONDS EXISTING CONDITIONS

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

4690041 | Figure 3-2

C15



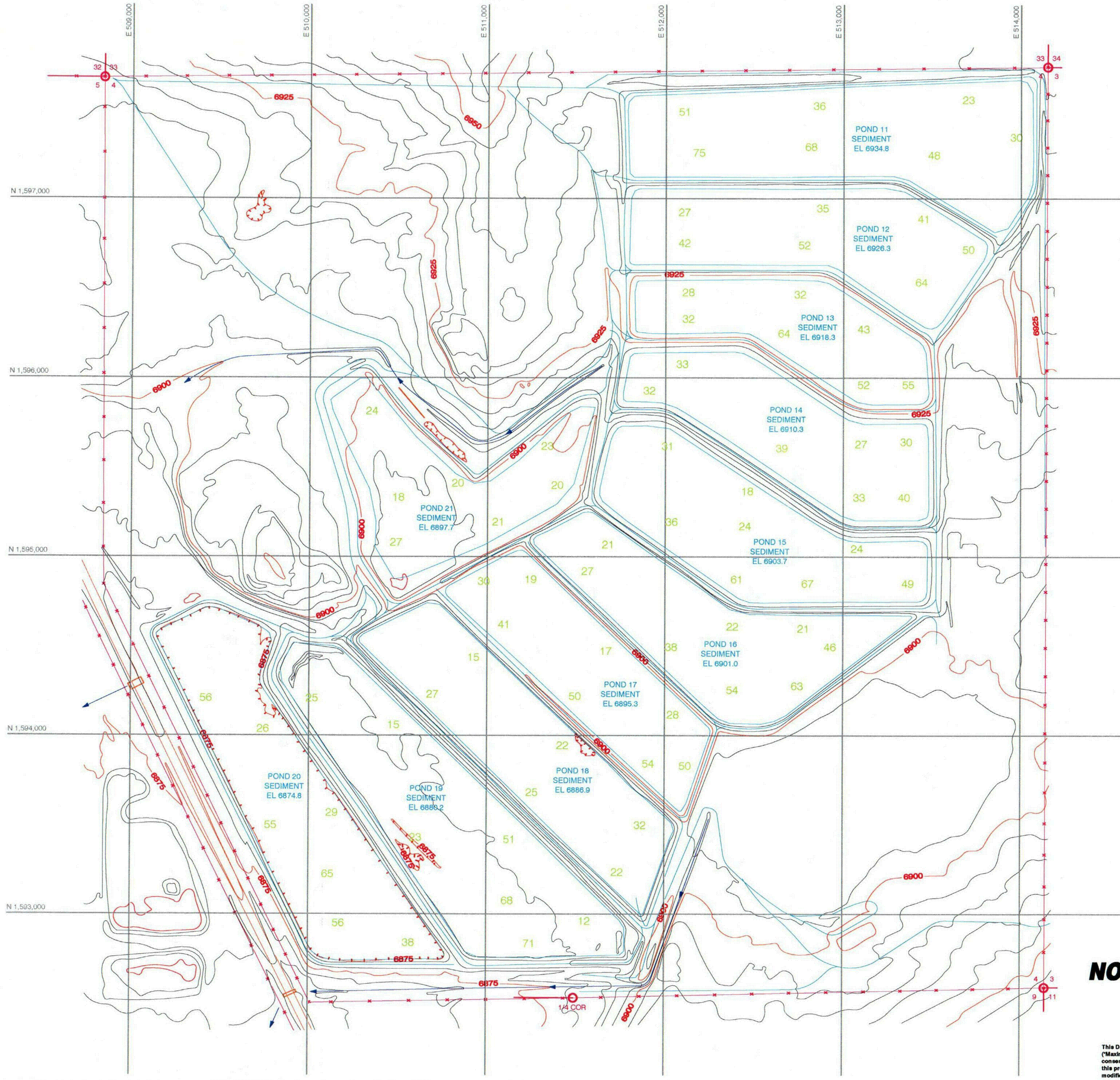
GENERAL SITE MAP

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

4690041	Figure 4-1

C16



LEGEND:

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- INDICATES ROADS AND TRAILS
- INDICATES EXISTING FENCE
- 23 INDICATES THICKNESS OF SEDIMENTS (inches)

NOTES:

1. CREST ELEVATIONS
   POND 11: 6942.0 ft
   POND 12: 6932.5 ft
   POND 13: 6927.5 ft
   POND 14: 6920.5 ft
   POND 15: 6912.5 ft
   POND 16: 6906.5 ft
   POND 17: 6900.0 ft
   POND 18: 6896.3 ft
   POND 19: 6890.3 ft
   POND 20: 6883.3 ft
   POND 21: VARIABLE
2. AVERAGE SEDIMENT ELEVATION PROVIDED. ACTUAL SEDIMENT ELEVATIONS VARIABLE WITHIN EACH POND. SEDIMENT THICKNESS SHOWN IN INCHES AT SPOT LOCATIONS.
3. TOPOGRAPHY ADAPTED FROM UNDATED KOOGLE & POURS ENGINEERING DRAWING.

0 300 600
SCALE IN FEET

NOT FOR CONSTRUCTION

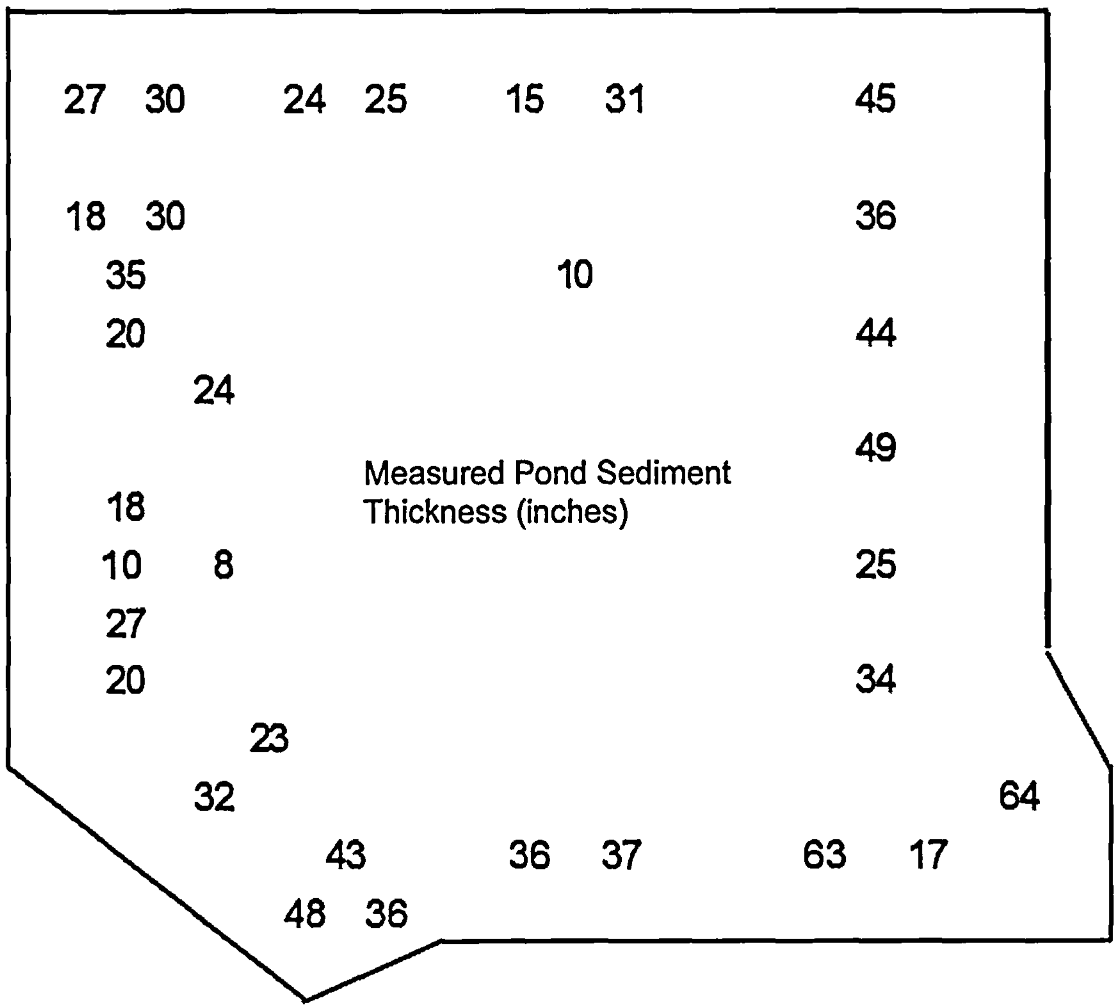
SECTION 4 PONDS
SEDIMENT THICKNESS

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

4690041 | Figure 4-2

C17



Area of Pond (acres): 24.44

Average Depth (feet): 2.5

Volume A (cubic yards): 99,348

Notes:

All depths given in inches.

Sediment depths only obtained along shoreline (within 50 feet of edge).

Depths do not include water above the sediment.

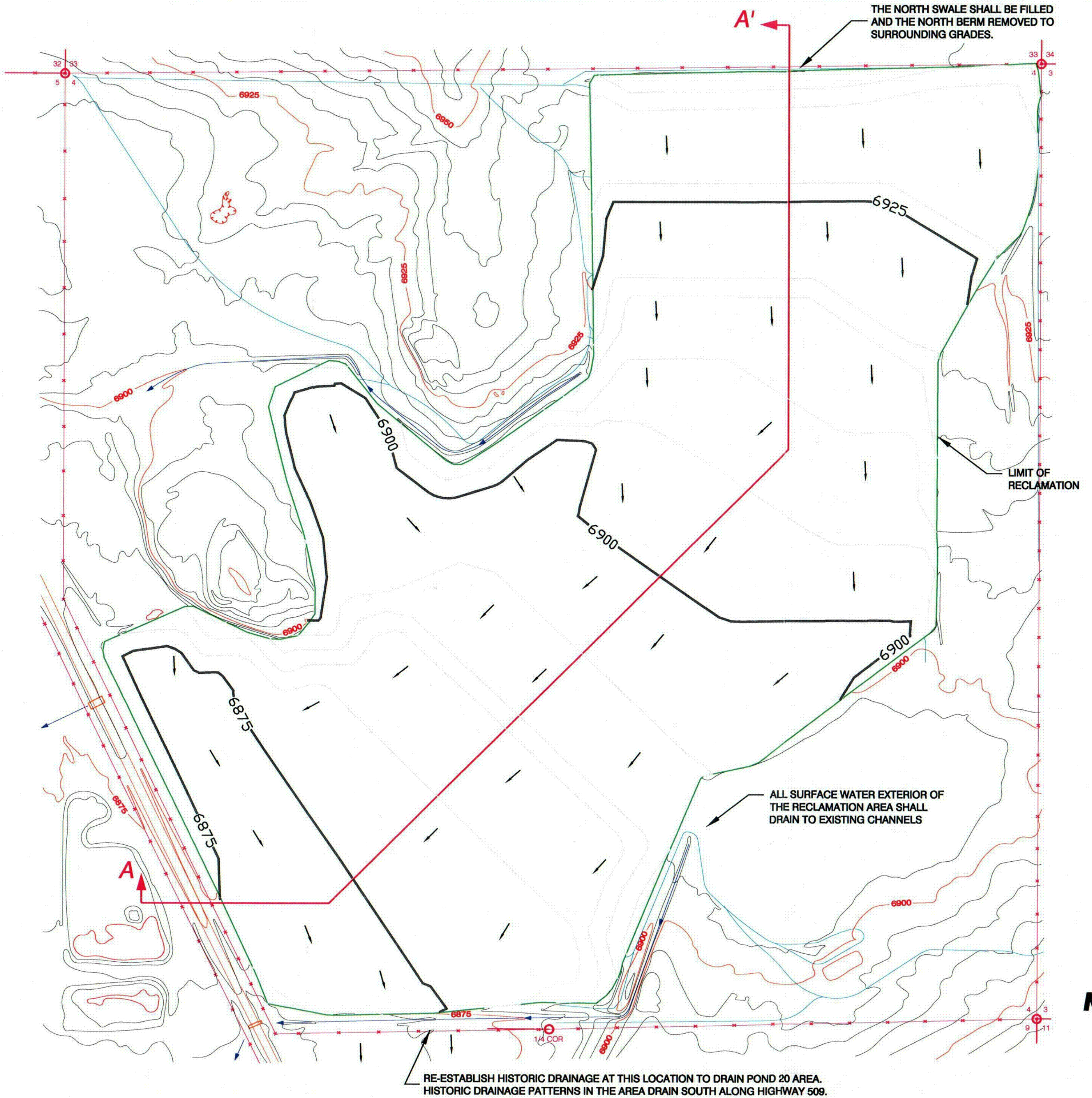
Shallow measurements correspond to points where liner has raised up within pond (whales).

POND 9
SEDIMENT VOLUME

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

4690041	Figure 4-3



LEGEND:

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- RECLAIMED INDEX CONTOUR
- RECLAIMED INTERMEDIATE CONTOUR
- INDICATES TRAILS AND DIRT ROADS
- INDICATES EXISTING FENCE
- 23 INDICATES THICKNESS OF SEDIMENTS (inches)
- FLOW ARROW

NOTES:

1. REMOVE ALL SEDIMENTS FROM PONDS AND DISPOSE AT THE POND 2 AREA OF THE MILL SITE.
2. REMOVE ALL GEOMEMBRANE AND DISPOSE AT THE POND 2 AREA OF THE MILL SITE.
3. REMOVE ALL CONTAMINATED SOIL AS DETERMINED BY ENGINEER AND DISPOSE AT THE POND 2 AREA OF THE MILL SITE (APPROXIMATELY 6 INCHES BELOW LINER).
4. APPROXIMATE POND BOTTOM ELEVATIONS, AFTER REMOVAL OF SEDIMENTS, LINER, AND CONTAMINATED SOIL, ARE PROVED. ALL POND BOTTOM AREAS SHALL BE UNIFORMLY GRADED TO A MINIMUM SLOPE OF 0.25% AND A MAXIMUM SLOPE OF 2% GENERALLY AS SHOWN BY THE FLOW ARROWS.
5. ALL FORMER EMBANKMENT AREAS SHALL BE UNIFORMLY GRADED TO A MAXIMUM SLOPE OF 5%. SLOPES SHALL BE CONSTRUCTED SUCH THAT UNIFORM SHEET FLOW OF SURFACE WATER MAY PASS FROM ONE FORMER POND AREA TO THE NEXT UNOBSTRUCTED.
6. TOPSOIL NORTH OF POND 11 SHALL BE EXCAVATED TO REMOVE CONTAMINATED SOIL AT THE DIRECTION OF THE ENGINEER. THE EXCAVATION IS EXPECTED TO BE ON THE ORDER OF 6 TO 9 INCHES DEEP AND COVER AN AREA OF 20 TO 40 ACRES.
7. ALL EXISTING DRAINAGE CHANNELS ALONG THE PERIMETER OF THE PONDS SHALL REMAIN IN PLACE AND REMAIN OPERATIONAL.
8. TOPOGRAPHY ADAPTED FROM UNDATED KOOGLE & POURS ENGINEERING DRAWINGS.

0 300 600
SCALE IN FEET

NOT FOR CONSTRUCTION

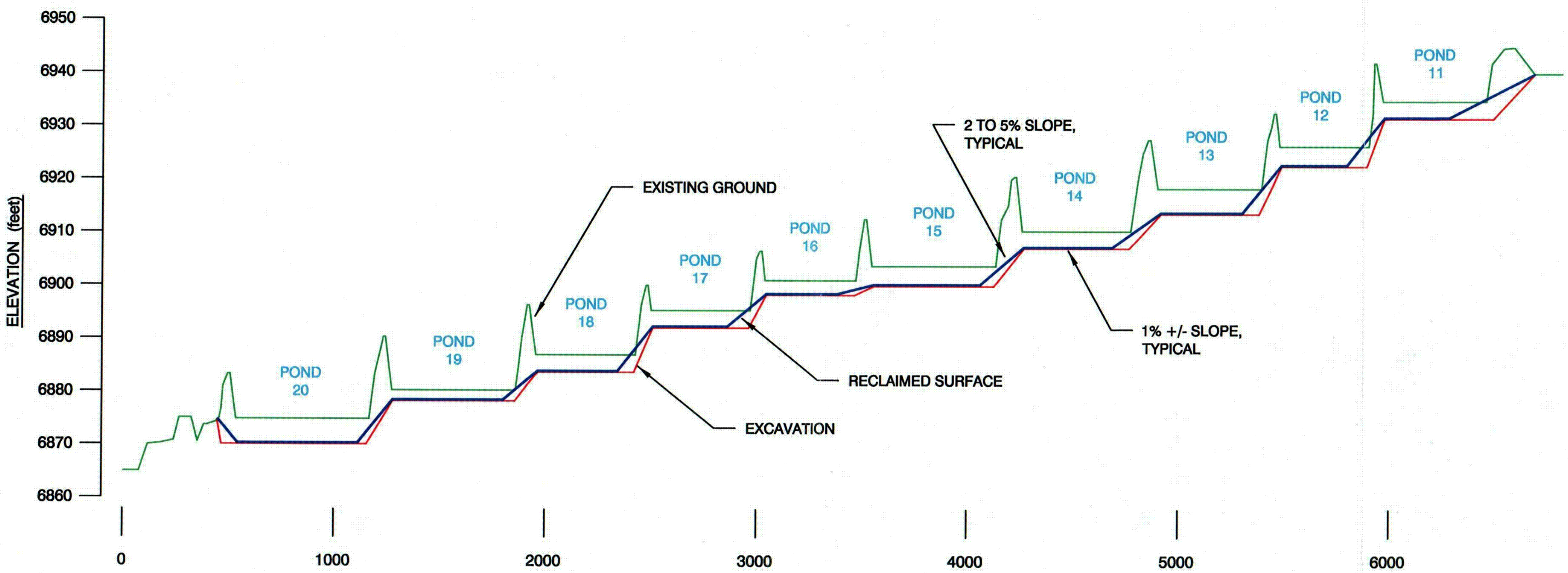
SECTION 4 PONDS RECLAIMED GRADES

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
RIO ALGOM MINING COMPANY, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES INC

4690041 | Figure 4-4

C18



NOT FOR CONSTRUCTION

CROSS SECTION RECLAIMED GRADE

SURFACE RECLAMATION PLAN
SECTION 4 EVAPORATION PONDS
AMBROSIA LAKE MILL
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